The North Sea and Baltic Canals.

Translated for ENGINEERING NEWS from the *Centralblatt der Bauverwaltung*, June 16, 1886.

The German Empire has long been desirous of having access for its navy and commerce to the Baltic sea without incurring the tedious and dangerous passage around the Danish coast. The government has now determined to build a canal, and the route has been selected and officially approved.

Like so many other canal projects, that of uniting the North sea with the Baltic dates back many a century. In fact, three canals have actually been dug at different times; the *Stecknitz*, one of the oldest canals in Europe and still in operation, was commenced in 1391 and finished in 1398; it is simply an inland canal, however. The *Alster-Trave* canal was constructed in 1525, but was destroyed by a war as long ago as 1550, and has never been reopened. The original project for the *Eider* canal dates back to 1571, but actual work was not commenced upon it until 1777, and it was finished in 1785 by King Christian VII, of Denmark. There are six locks in this canal, having an available length of 105 feet and a width of 26 feet and a depth of 10½ feet.

Plate 1.—General Plan of the Various Canal Routes.

While these earlier canals were to serve exclusively the interests of commerce, the numerous later projects had besides military and political ends; and this may be especially said of all plans coming from German sources. The projected routes may be geographically divided into three classes, viz: The projects in North Schleswig; those of South Schleswig, which were to traverse the Jutland peninsula, and lastly the various routes through Holstein.

All of these lines are shown in the map, Plate 1. Line 1, from Ripen to Kolding, and line 2, from Ripen to Hadersleben, date from 1553-59. Line 3, runs from Ballum to Alpenrade, and is one hundred years later in date. Line 4 was advocated by von Justi in 1761, from Hoyer to Flensburg, and it was closely investigated again in 1872, but was finally rejected. Line 5, which has many favorable features, was also suggested by von Justi in 1761, and has been urged by engineers in our times; it runs from Husum to Eckernfoerde, but the approaches to the mouth of the Hever, on the west, with their insufficient depths and ever-changing channels do not adapt it to navigation by war-ships. This last route, as well as that urged by the Naval Committee of 1848, with the deepening of the Eider and the Eider canal, belongs to the second geographical group or class. The third and following class is of a more diversified nature, resultant upon the importance of the mouth of the Elbe as a western terminus, the ownership of Holstein by Germany and the proximity of Hamburg, Keil and Lübeck.

As a matter of historical interest, it may be mentioned that Wallenstein had commenced a canal hereabouts as early as 1628; and to Cromwell is attributed a project of seizing Weimar and connecting it with the Elbe by an ocean-canal, by way of the Schwerin lake.

The remaining projects originated in modern times, and among the more prominent of these is the plan advanced by the Christensen Brothers, in 1848, to connect Brunsbüttel with Eckernförde by a sea-level canal (line 7.) No locks would have been required. This route was modified by Jansens in 1863, and Büsum was to be the terminus (line 9.) Project No. 10, Brunsbüttel, Rendsburg, Keil, had already been proposed by the Naval Committee of 1848, and is a combination of lines 6 and 7. Plan No. 11 was suggested by Major Christensen in 1849; six locks were to be used, and the canal would have followed almost a straight line from Brunsbüttel to Keil. Gudme's line, No. 12, is of lesser importance, and would only have been passable by small vessels. Several other projects, Nos. 13, 14, 15 and 16, were intended to connect the Elbe at Brunsbüttel, St. Margarethen or Störst with Lübeck, Travemuende, or other points on Newstadt bay. These, though of great value to Lübeck, would have required locks and have been costly; they were abandoned mainly on account of the rapidly growing importance of Keil as a naval station.

The Prussian government up to 1866 had considered four principal projects, worked out by Leutze, viz. I, The main project from St. Margarether, via Rendsburg and Steinrade, to Eckernförde; canals at mean tide level of the Baltic, locks at the Elbe, Baltic end open and draining towards the Baltic. II. From St. Margarethen, via Rendsburg and Steinrade, to Kiel with same conditions as above. III. Route the same as No. II, but with locks at both ends of the canal and a general canal level 6 to 8 feet above Baltic mean tide. IV. This last plan has the same route as No. I, with the addition of a short branch from Steinrade to Kiel for war-ships, and using six locks, with a lock at Wittenbergen connecting with the existing narrow Eider canal.

The war of 1866 stopped these projects. In 1878 the matter was again vigorously taken up by Herr Dahlström, a Hamburg merchant and ship owner. He intended originally to accomplish the work through a private corporation, and the government gave him permission to make the necessary field studies for a route, Brunsbüttel, Rendsburg, Kiel. Leutze's plans were placed at his disposition. Herr Boden, who attended to the engineering part of the project, made several important and very valuable alterations, and finally in May, 1881, the Dahlström-Boden route from Brunsbüttel via Wittenbergen, Rendsburg, Steinrade and Knoop to Holtenau, in the bay of Kiel, could be submitted to the authorities. After a reconsideration and readjustment of the line in minor details by the Prussian Department of Public Works, it was thoroughly discussed in the legislative bodies of 1881, 1883 and 1884. Final action was taken on the 10th of June of this year, and the canal is now being built by the Imperial government.

The Route and its Construction.—The adopted route will be seen on Map No. 2. The importance of Kiel as a naval station fixed the eastern terminus; and the generally deep fine harbor and navigable water of the Elbe mouth was taken into account on the west. Some improvements of the western entrance will have to be made immediately above Cuxhaven, however, but the ports of London and New York, with greater amount of shipping than can ever be expected here, offer greater obstructions to navigation. At Brunsbüttel the Elbe has a minimum low-water depth of 29½ feet, so that war vessels could use it at low tide.

Starting from Brunsbüttel, the canal first passes through the low swampy land of the *Marsch* and then through gradually rising ground to the water shed of the Elbe and the Eider at Gruenthal with an elevation of 82 feet above datum. Both Christensen and Leutze had long previously pointed out the exact location of this crossing, as approved by the Government report and Dahlstrom. From this summit the line then follows the course of the Gieselau and reaches the Eider near Wittenbergen, at which point the river will be cut off. The further middle course of the Eider to Rendsburg, thus cut off from tidal influence, will be utilized as a canal with suitable grades, the route then follows the upper Eider lakes, and with considerable rectification, especially near Schestadt and Holtenau, is continued on the present Eider canal.

As this work is yet in its preliminary stage

only a very general idea can be given of its constructive details. In the main, the principles of the Dahlstrom—Boden project will be adhered to, but considerable revision will be necessary to meet the naval requirements and certain natural difficulties. More favorable crossing points may be found on the crests of the water shed, and the number of curves may be considerably reduced. Dahlstrom and Leutze suggested a minimum radius of 2,460 feet, but this can be changed to 3,275 feet without any material increase in cost. But either minimum radius will be used but seldom and those of 4,900, 6,500 or possibly 9,800 feet generally employed. The chief value of this canal will lie in the speed with which vessels can traverse it, and for this reason the curves will be as gentle and as few in number as possible.

The average cross-section of the canal is

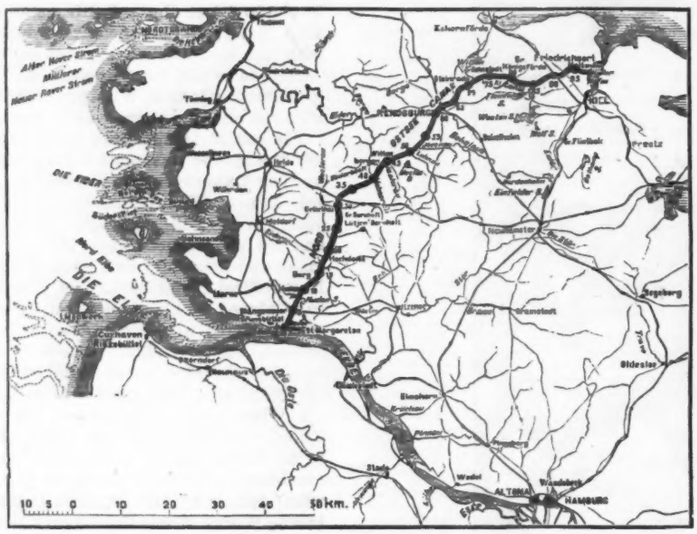

Plate 11.—Plan of the North Sea Canal.

85 feet 3 inches at the bottom, 197 feet at the water surface and 27 feet 10½ inches deep; these dimensions exceed those of the Suez Canal and will permit the passing of ordinary ships at any point. The largest Baltic steamers draw 19 feet 8 inches, with a beam of 39 feet 4 inches. At this depth of 19 feet 8 inches the canal will have a width of 118 feet, so that there will be a clearance of 39 feet 4 inches between the slopes and two such vessels passing each other, even assuming that the vessels have a rectangular cross section which they have not. Practically the clearance will be nearly 33 feet. The upper Eider lakes and a few specially arranged passing stations will afford all the room requisite for war-ships. In order, however, to meet any future increase in the section of vessels using the canal, a strip of land about 33 feet in width will be at once purchased along the southern bank. The immersed hull-section of the large Baltic steamers is 655 square feet, and the canal section has 3,920 square feet, thus affording a proportion of about 1 to 6, which is considered adequate from a navigable point of view and will allow a speed of 5.3 knots. The depth of 27 feet 10 inches, which may be increased to 29 feet 6 inches is demanded by the draft of war ships and will greatly facilitate the handling of merchant vessels.

The slopes of the canal may also be made flatter in the lower portions and made steeper above towards the water surface, especially as all parts exposed to washing will be protected by paving.

The profile of the canal shows a generally level water line corresponding to mean tide in the Baltic. The canal is thus a thorough cut without any locks except at the entrances. The Upper Eider lakes, which are now raised by dams at Rendsburg, will eventually be lowered and the five locks on the Eider Canal removed. As to the entrance locks, the tide in the Elbe ordinarily fluctuates from 4 feet 3 inches below to 4 feet 9½ inches above the canal level; while the highest tides rise about 12 feet above the mean level of the Baltic.

The locks at the eastern mouth, added by Dahlstrom-Boden to Leutze's plan, are undoubtedly necessary, as proven by the Baltic storm of November, 1872. Boden drained into the Elbe by his plan while Leutze drained principally into the Baltic; the government plan retains these suggestions, but proposes special outlets instead of permitting the water to drain through the ordinary locks. The ordinary tide in the Baltic fluctuates but 20 inches below and the same above the canal level, and the locks will only be used when the tides exceed this figure. The Eider, where it is shut off from its upper portion at Wittenbergen, will be connected with the canal by a lock, thus allowing the use of the Eider and relieving the principal locks at the Elbe, and making really two western mouths.

In the construction of this canal the larger locks will be the chief feature. Dahlstrom had two locks in view at the Elbe end,—a large one with an available length of 412 feet and width of 82 feet, and a a small one 275 long and 41 feet wide. For the Baltic end he had simply provided one large one. But to accommodate heavy war ships, a large basin-lock has now been added to the two separate Elbe-locks with a length of 1,180 feet and a width of 196 feet. This will afford a harbor for a very considerable fleet of war or trading ships. To prevent mud deposits the flow of the tides will be utilized in connection with special flushing devices. A large basin-lock is not required at the Baltic end, as the lock is ordinarily open. The depth of water in the large locks will be regulated by the lowest tide levels, with a minimum depth of 27 feet 10 in.

The smaller Elbe lock does not quite come up to Dahlstrom's standard, and the lock at Wittenbergen will be 233 feet long by 37 feet 8 inches wide, and have a depth of 16 feet below the canal level. The requisite shops and store-houses will be built at the Elbe and at Holtenau, and all the locks, basins and quays will be of very solid construction, with machinery driven by hydraulic power. Drawbridges will be built for the four railways and two main highways crossing the canal line, with a clear span of at least 115 feet; at other highways steam or boat ferries will be established.

The estimated cost of the canal is as follows:

Purchase of ground, etc.	$ 2,475,000
Earthwork and dredging	17,725,000
Protecting banks	1,800,000
Harbors, locks and quays	9 062 500
Bridges and ferries	1,6.5 000
Milita y requirements	250 000
Buildings	325,060
Working plant, machine shops, etc	562,500
Miscellaneous	5,125,000
Total	$39,000,000

The annual cost of maintenance and general operating expenses is set down at $450,000, and the renewals at $25,000 more.

The military advantages to Germany of such a canal need not be dwelt upon here. The commercial advantages will be, the avoidance of pilot and other dues now levied by the Danes and a saving of distance by vessels coming from the south or west of London of 237 sea miles, while for German ports the saving in distance is much greater, for Hamburg, 425 miles. Sailing vessels will be especially benefited as the passage around Denmark is long and dangerous; 200 vessels being lost annually about the Scaggers.

The canal-toll is figured at 18¾ cents (75 pfennigs) per registered ton, and the Sound traffic has been estimated by Dahlstrom at 40,600 vessels of 12,240,000 tons register, with an amount available for the canal of 9,210,000 tons.

The Foundations of Venice.

From investigations made by Signor Boni, one of the architects of the Ducal Palace, the following data is gathered as to the soil beneath the City of Venice and the methods of the early builders in preparing foundations:—

Judging from the cylinders of material taken up in the artesian well borings, the subsoil of Venice for at least 1,000 feet in depth, is an alternation of clay, sea-sand, mud and carbonaceous matter.

In founding the palaces of the twelfth to fifteenth centuries, the practice was to excavate the debris until solid clay was reached; and when great stability was required piles were then driven down to and through the next stratum of firmer and more resisting clay into the sand stratum beneath. These piles were first driven in a hollow square and the inside area was then filled with piles driven as closely as possible and finally fragments of stone were rammed in between. On the heads of the piles a platform of oak planks, several inches thick, was laid in crossing layers and upon this platform the foundation of squared stones was commenced.

The wood thus used in the fourteenth century under the campanile of St. Mark's is still found in perfect preservation. Signor Boni recently laid this foundation bare, and found that this substructure, which carries a load per square foot of about eight tons, is 50 feet square at the pavement level and only 56 feet square at 16½ feet down where it rests upon the wooden platform.

Under the Ducal Palace there is only a stone foundation, 9½ feet deep, resting directly upon a clay stratum and without piles. The pile work under St. Mark's is only about 7 feet deep. Both of these structures have settled greatly; in the portico of the latter string-courses that must once have been horizontal are now 10 inches out of level, and the old pavement is found 27½ inches below the present paving. The Ducal Palace in like manner has apparently settled to the height of three steps in the approach; but this may be due as well to the gradual filling up of the street, and if the palace has actually settled it has gone very equally. St. Mark's, however, is in bad condition, the walls fractured, mosaics and facing marble injured and pavement cracked and bulged up by settling down on masonry piers built beneath it.

On the Selection of Steam Pumping Machinery.

BY ALFRED R. WOLFF, M. E.

Written for ENGINEERING NEWS

The practice of calling upon the engineer to design special pumping engines for a particular water-works may be said to be dying out, so limited is its present status, so marked its decrease as compared with years gone by. Exceptional indeed must be the circumstances, when the prominent builders of pumping engines can not be called upon to supply exactly the machinery most suitable, from their regular stock or by but slight modifications of their regular patterns.

The advantages of decreased first cost, due to saving of outlay for special design and patterns and in cost of "experimenting" and construction, are so patent as to demand little emphasis on our part; and when coupled to this, the builders' long special experience and exceptional facilities ensure a guaranteed economy, while the economy of a new and untried design is always to a great extent a question, it is not surprising that the practice to-day is as we have intimated.

The engineer advising capitalists or city authorities in the matter of pumping machinery for water-works, therefore, usually finds his work, if he would be of greatest advantage to his clients and not let the selfish consideration and pleasure of "original design" blind his judgment as to the facts, confined to the limits of determining the type and capacity of pumping machinery which will best answer the special needs, and then selecting from bids of prominent builders invited to fill the prescribed and specified needs, that machinery which will secure greatest economy. It is a consideration in the latter problem of "greatest economy," which is to specifically and briefly engage our attention in this paper.

When the engineer has decided upon the general type of pumping machinery most suitable, he will find, as a rule, that several leading and well-known pumping engine manufacturers can supply his needs, but their bids will show a large variation in the first cost, and also in the guaranteed duty. It may be that the amount of capital available is so small that the machinery which will give the pumping capacity for the least first cost, irrespective of the question of long life and fuel economy, will have to be selected, but this is a rare occurrence and decidedly bad practice. Fortunately the problem seldom presents itself in this shape, for if it can be shown to capitalists that by securing a better (viz: more durable and more economical) steam plant for a given capacity, the money return of the investment in per cent. of invested capital, will be greater, there is little difficulty in securing the amount of capital needed. Usually, therefore, the feature of first cost is not, of itself, determining in the way of limiting the selection, on the score of the amount of capital that can be expended.

On the other hand, the problem does not resolve itself into securing the steam pumping machinery, which will give the required capacity or duty for the least steam or fuel consumption. This leads to the point of this paper, which is to emphasize the fact that, having determined upon the class of pumping machinery suitable, and having obtained bids from leading manufacturers for the class of machinery determined upon as suitable, it is the engineer's duty to select or recommend that pumping machinery which will reliably give the capacity for the least current money expense, such annual running expense being *the sum of the annual interest on the capital expended, the repairs and depreciation of plant, the cost of fuel, salaries of attendants and the like.*

It is this *sum* which should be a determining element in the selection. A saving of fuel, viz., a higher duty, counts more on the Pacific Coast with rates for anthracite coal at say $10 a ton, than on the Atlantic Coast with rates at say $4 a ton, and accordingly the Water Works Company or city authorities of the Pacific Coast can afford to pay more in first cost of plant to secure an increased fuel economy than can the authorities on the Atlantic Coast for the same pumping capacity and fuel economy.

The first cost enters the problem in the shape of annual interest, and also as depreciation in the annual expense account, the plant being considered as losing a percentage of its original value each year, so that after a prescribed number of years it is presumed to be valueless. The rate allowed for depreciation depends upon the life of the plant, viz., for the same extent of use, upon the excellence of construction and special make, and therefore is a variable and complex factor in the problem, increasing in one respect with the first cost (on account of capital invested), but decreasing in another respect in proportion as this increased first cost implies, as it frequently does, superiority of material, workmanship, stability and strength of structure.

It is the engineer's duty to determine to his best ability, from his experience and judgment, what annual rate should be allowed for the several elements of interest, depreciation, repairs, attendance and the like for each pumping engine included in the bids, and it is not our purpose to discuss what is the proper allowance to be made. We would say, however, that in estimating the fuel expense, it will not do to assume the boiler evaporation or economy attainable in a test—the figure not unfrequently adopted in the guarantee of builders of pumping engines—,but to allow for the less good showing which can be relied upon in,and represents,actual practice,year in year out, when the boiler is not in the exceptional condition and is not so carefully fired as are the usual features of special economy and duty trials. It will also be well to allow for boiler power double that needed for full working capacity of pumping engines, by securing a duplicate set of boilers, so that while one boiler, or one set of boilers, is at work,the other is idle and can be undergoing requisite cleaning and repairs. Intermittent running can alone ensure long life and durability of the boilers, and prevent absolute break-downs and the serious inconveniences and losses consequent thereon.

The following table, which is adapted from the writer's professional work, is presented as an illustration of the purport of this paper, and virtually explains itself. Though it represents an actual case of practice, it has been modified so as to cover its identity. It will be noted that in the table as given the same percentage for interest and depreciation is allowed for the several engines named, but, in fact, on account of the different degrees of durability which the writer believed to exist in the various pumping engines referred to, quite a variation in the rate per cent. was figured for depreciation and repairs, and separate items calculated for the annual "depreciation and repairs" account, and for the interest accounts. In the table both these accounts are summed up at 16 per cent. per annum. This rather high per cent. for the best pumping engines is due to the fact that interest rates quite high at the locality where capital was available and pumping machinery erected. Wages account not included, for this would be the same for the different engines; but for larger plants this is apt to enter as a varying element.

The table is not given so much with the idea of presenting exact figures, but rather as an illustration of the principle involved. It will be noted,and it is the writer's experience, that the amount of difference in the total annual expense is not great between good pumping engines, even if of quite different first cost. The fierce competition between rival pumping engine manufacturers would indeed, on reflection, suggest such a result, but analysis of the class indicated shows it plainly.

Finally it may be remarked that the contract was not awarded to *D*, the maker of the engine which, in the table, shows the lowest annual expense, and is the second lowest in cheapness of first cost. In the writer's opinion the engine lacked the required durability, and its lesser life and greater probable repairs, made necessary an allowance for interest, repairs and depreciation, so much in excess of the 16 per cent. adopted for the best-constructed engines in the list, that the relative economic showing was quite different from that indicated in the table. The same comment applies to *C*. The pumping plant was erected in a locality far removed from machine shops and other engineering facilities, so that long life and minimum repairs were of great importance.

Estimated Annual Expense Account * * Pumping Engine as per Bids.*

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
Name of Maker.	For interest, depreciation and repairs, (16% on first cost of engine.)	For coal at 0.44 cents per pound, 600,000 gallons of water raised 150 feet per day of 10 hours run.	For coal at 0.44 cents per pound, 1,500,000 gallons raised 150 feet per day of 24 hours run.	For interest, repairs and depreciation of twice actual boiler capacity needed to furnish requisite quantity of steam per hr	Total Annual Expense of Plant, for Interest, Depreciation, Coal, etc. When 600,000 gallons are raised 150 feet per day of 10 hours.	Total Annual Expense of Plant, for Interest, Depreciation, Coal, etc. When 1,500,000 gallons are raised 150 feet per day of 24 hours.
					Sums of cols 2,3 & 5	Sums of cols 2,4 & 5
	$	$	$	$	$	$
A	1920	1496	3740	162	3578	5822
B	1680	1672	4180	192	3564	6042
C	595	2153	5383	234	2982	6212
D	672	1893	4707	201	2756	5580
E	1056	1935	4837	208	3199	6101
F	1312	1772	4430	192	3276	5934

Steel Railroad Ties.

From the Mexican Financier.

The Mexican (Vera Cruz) Railway Company has, in an experience of two years, thoroughly tested steel ties. The road began using steel ties in 1884, and has now some 20,000 of them on its bed. So satisfactory has the experiment been that 40,000 more have been ordered from England for use this year, and it is proposed to put in from 40,000 to 50,000 per year hereafter. The "life" of a steel tie is considered as indefinite, but it may safely be set at from thirty to fifty years, the former being an American estimate by a competent metallurgist. The steel tie is now produced in England—where the manufacture has been so extended as to make the production very much cheaper than formerly—for five shillings apiece, or $1.25 gold. By chartering its own vessels, the Vera Cruz Company can land its steel ties here at a cost which permits their extensive use. It may be set down that the outside cost will not exceed $2 each, Mexican silver. The wooden ties which the steel ties are replacing on the Vera Cruz line range in price, according to the quality of wood, from 90 cents to $1.62, silver. The latter price is paid for the zapote tie, a very hard and durable wood. The best white oak ties last from five to six years, the red oak about three years. In India the steel tie, sent out from England, is displacing even the teak tie one of the best woods, and the change is being made on the score of economy. In using the steel tie the expense of spikes is saved.

Municipal Engineering; Pape No. 3.*

WASHINGTON, D. C.

(*Continued from Page* 183.)

Water Distribution.

All pipes are laid so that the upper surface of the pipe shall be 3 feet below the surface of the street.

Service pipes are of galvanized-iron and are of three sizes, viz: ½, ¾ and 1 inch in diameter. Connections are put in every 20 feet except where the adjoining lots are built on, where they are put in to accommodate the houses. There is a stop-cock for shutting off the water, on each service pipe, just inside the curb. The water-stop-cock box used is shown in Plate 13. The service tap is shown in Plate 14. This consists of a brass cock which is tapped into the main, the outer end having a screw cap which holds a flanged goose-neck, the outer end of which is joined to a piece of lead pipe about 18 inches in length; bent so as to bring as little strain as possible on the cock in case of settlement of the service pipe. To the other end of the lead pipe is joined a short piece of brass pipe, to which the galvanized-iron service pipe is attached.

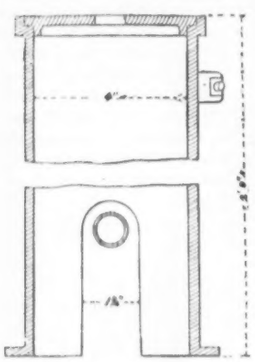

PLATE 13. WATER STOP-COCK BOX.

The manner of tapping a pipe under pressure is shown in Plate 14. Fig. 3; a hole is drilled nearly through the sides of the pipe, a thread tipped and the cock screwed in. The goose-neck and cap which hold it are taken off, and a drill that exactly fills the hole in the valve is inserted; a cap that fits tightly around the shank of the drill, with suitable packing to form a water-tight joint is screwed on and a hole drilled through. The drill is then withdrawn sufficiently to allow the plug to be turned and the water shut off, after which the cap and drill are removed and the goose-neck attached. This arrangement can be used with any convenient form of drilling machine.

The location of each service connection is taken from some convenient fixed point on the surface and a record kept in the engineers' office.

Water-mains are laid by the city, but a special tax of 1½ cents per square foot is assessed against all property fronting on the street, without regard to the size of the main or cost of the work.

Fire-Hydrants.

Fire-hydrants are generally located near the intersections of streets, and are placed in the sidewalk within about a foot of the curb of one street and between the building line and the parking line of the other street, as shown by the accompanying sketch (Plate 15). In the business portions there is one at each corner and usually one about midway of the square. In the residence portions they are about twice as far apart. The total number in the city is 720. A hydrant patented in 1864 and manufactured by J. McClelland & Co., (see Plate 16,) is the only one used in the city. The following specification is taken from the advertisement for proposals for furnishing hydrants:

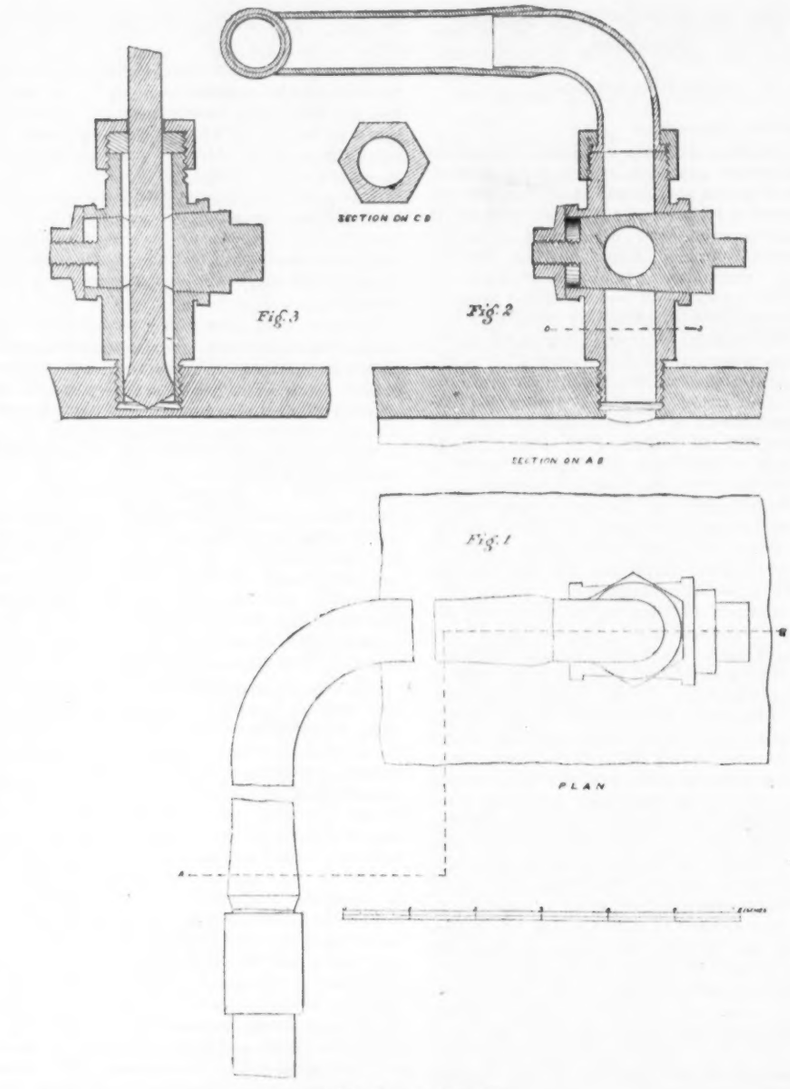

Plate 14.—Service Tap.

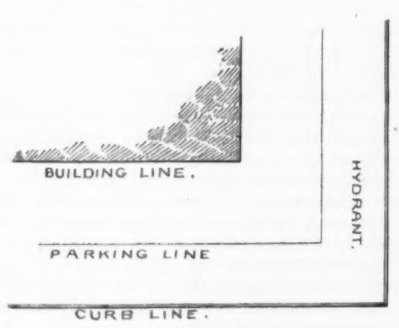

Plate 15.

Specification.

"The fire-plugs must be of some standard manufacture, with 6-inch stand pipe, with three outlets of 2½ inches diameter, the outlet towards the street to be capable of easy replacement by one of any desired greater dimension. Each outlet must have its own separate cut off or stop valve."

Plate 19.—Extension Stop-box.

In this hydrant the valve is of iron, with a

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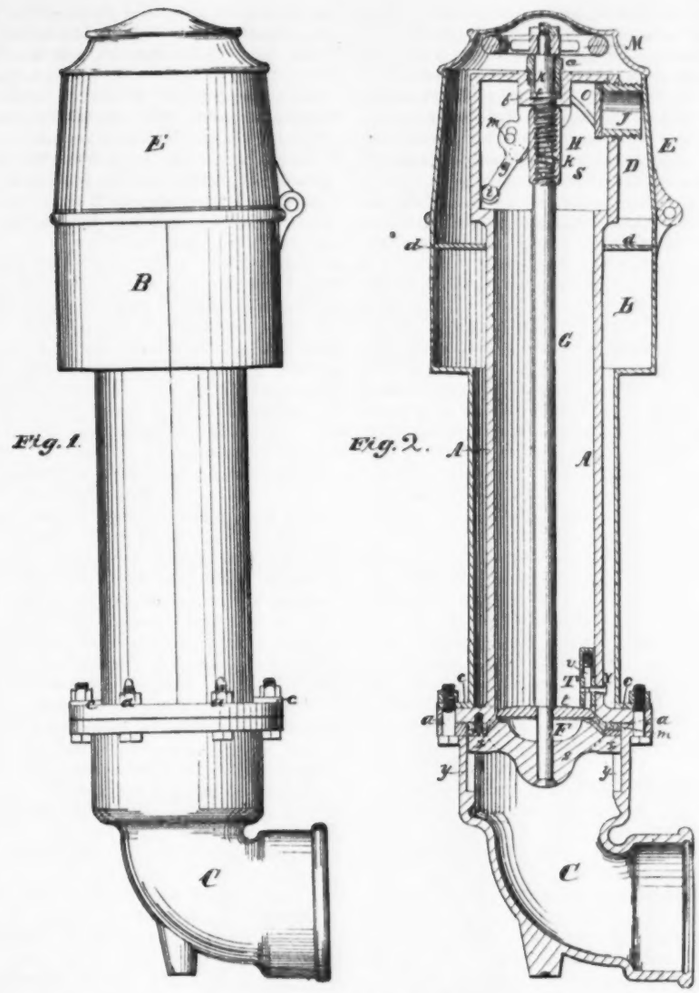

Plate 16.—Fire Hydrant.

brass rim around it which closes on a lead seat. The valve is opened by turning a hand wheel at the top of the hydrant. The standpipe has no jacket except for a short distance below the surface of the ground, and for a short distance just at the valve. The valve sets about 4 feet below the surface of the ground. The upper portions of the jacket, which covers the hand wheel and nozzles, turns back on a hinge when in use. When closed the cover is locked to prevent evil-disposed persons from tampering with the hydrants. These hydrants have been in use for a number of years and have given good satisfaction.

Stop-Valves and Boxes.

The stop-valves for water-mains shown in Plate 17 are also patented and manufactured by J. McClelland, of Washington, D. C., and are the only ones used in the city. This valve consists of a hollow conical plug, which is raised vertically by means of a wrench applied to the upper end of the screw passing through the cover of the casing and the hollow plug. This valve is made of cast-iron, with gun-metal rings cast into the iron to form the valve-seats. The hollow inside the plug is made larger than the supply-pipe, so that any stones, gravel, or any hard substance which can pass through the pipes can be received into the cavity and not prevent the valve from closing. The box used in connection with this valve is shown in Plate 18., page 198.

The stop-box used by the gas company on service-pipes is shown in Plate 19. This is an extension box patented by A. W. Morgan, and manufactured by Bingham & Taylor, of Clifton Iron Works, Buffalo, N. Y. The boxes are made in two pieces, one screwing into the other so as to be more readily adjusted to the grade of the surface of the street.

(TO BE CONTINUED).

Engineers' Surveying Instruments.—Their Construction and Use.

IV.

Written for ENGINEERING NEWS.

BY I. O. BAKER, C. E. PROFESSOR OF CIVIL ENGINEERING UNIVERSITY OF ILLINOIS.

THE TRANSIT.

1. This is the name usually given to instruments in common use among American engineers for measuring horizontal and vertical angles. It is sometimes, but incorrectly, called a theodolite. The theodolite is the name given by British engineers to their favorite portable instrument, which is capable of performing the same work as the transit. The essential difference between the transit and the theodolite is that in the former the telescope can transit or turn completely over, while in the latter it cannot. The telescope of the theodolite can be reversed only by lifting it out of its supports and replacing it end for end, which is a very imperfect substitute for the revolution of the telescope of the transit. The transit is sometimes called an engineer's transit, or railroad transit, to distinguish it from an astronomical transit. The transit was invented and first made by a Philadelphia firm in 1831, previous to which time the English theodolite and the magnetic compass, sometimes provided with a full circle graduation by which angles could be read independently of the needle, were the common angle instruments.

The great value of the transit as an instrument of precision is due to the telescope, by

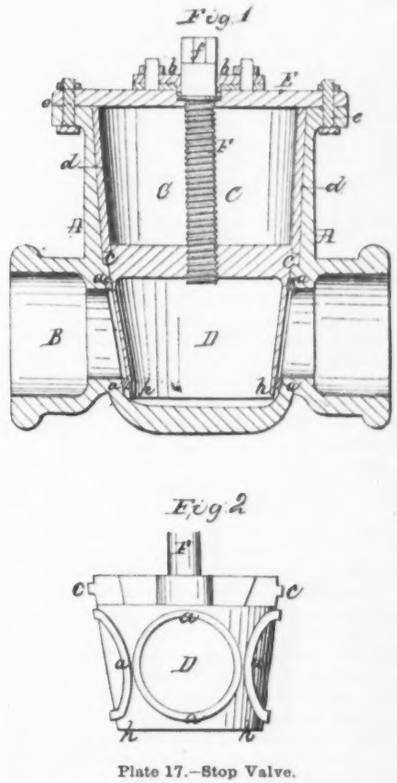

Plate 17.—Stop Valve.

which great precision in sighting is obtained, and to the graduated circle with its vernier, by which angles can be read with ease and accuracy. All other parts are to facilitate the use of these two.

2. THE TRIPOD.—The manner of connecting the leg with the head needs attention. The leg should not be placed between two lugs or ears which are fastened to the plate, for in case the leg wears or shrinks there is no adequate means of making the leg fit. Drawing the ears together by a screw, bends the plate, and even then only partially remedies the evil. An excellent form is that in which the leg is made of two pieces that bear upon opposite sides of a lug cast upon the plate. Sometimes the leg is in one piece and slotted at the top, which is also very good. Another good form is that in which the leg is not open at the top but bears upon only one side of the lug. In the three forms last mentioned, any looseness is taken up by a thumb-nut. Sometimes the leg is inserted in a metal cap which is then fastened to the tripod head: this is better than putting the leg directly between two metal ears, but it is not as good as any of the others.

To set the tripod, notice 1st, that to allow the position of the plumb-line, the legs must be swung on their pivots but not sidewise; and 2nd, that to put the plate level, the legs must be swung sidewise but not on their pivots. These two points, though small in themselves, are worth remembering as a means of saving time and labor and also of preventing unnecessary wear and strain on the leveling screws owing to faulty construction of the leveling appliances.

With many instruments the last point is a very important one.

Attention to the following principles also will save much time and hard labor in setting the tripod. Let the lines radiating from c, Fig. 10, represent lines joining the feet of the tripod legs with the point over which the

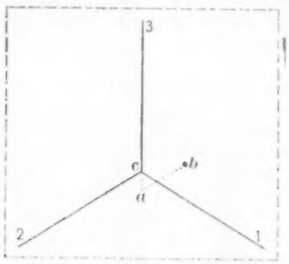

FIGURE 10.

plumb bob is to be placed; b is the position of the plumb bob. It is desired to move the plumb bob from b to c. Press the leg 1 into the ground until the bob swings into the line 3 c prolonged; then force 3 in until it swings to c. In general, press one of the legs into the ground until the plumb bob swings to the opposite side of the point from one of the other legs; then press that leg in until the plumb bob arrives at the center.

The tripod should be set firmly, but a great deal of time and effort is frequently wasted in forcing the legs into the ground needlessly. Setting the tripod is an operation that must be repeated many times, and the beginner should learn to do it quickly and easily.

In case the pointed plumb-bob is lost and only a rough piece of some heavy substance can be had, the instrument may still be plumbed down accurately by holding a second plumb line before the eye in such a position that the eye shall be in the same plane with the two lines; then, without moving the eye, mark a line under the instrument in the plane. Repeat the operation at 90 degrees from the first position.

The intersection of these two is the desired point. The writer heard of a railroad surveying party waiting ten hours while the transitman sent for a plumb bob, which was almost as bad as being "delayed two days by a hornet's nest."

3. Leveling Screws.—Some instruments are provided with three leveling or foot screws, and others with four. The instrument can be leveled more quickly with three than with four; besides three are more delicate, and are less liable to strain and damage the instruments. The best instruments never have but three screws.

A very serious defect in many instruments with four leveling screws, is that the lower ends of the screws are above the center of the ball and socket joint which fastens the upper part of the instrument to the tripod. When one pair of screws is being used to level the plate, the upper part of the instrument must revolve about a line parallel to, but below, a line joining the feet of the pair not in use; therefore the instrument cannot revolve without causing the screws not in use to bind, and it can turn only by causing the feet of the screws to slip on the lower plate. Besides the annoyance in leveling the instrument, this binding tends to bend the screws and warp the plates and the slipping defaces the instrument by cutting spherical holes in the lower plate. Placing the feet of the screws in small cups obviates the holes in the upper face of the lower plate but increases the objections in the other and more important respects.

The defect may be remedied by bringing the center of the ball and socket joint into the plane of the feet of the foot screws. As there is no ball and socket joint with three leveling screws, this defect can not exist in that form of construction. A spiral spring fastens the instrument to the tripod. Since nearly all instruments possess the above defect, it is very necessary that the instrument should be leveled approximately by manipulating the tripod legs as already described.

Whatever the number, there should be no looseness between the screw and the nut.

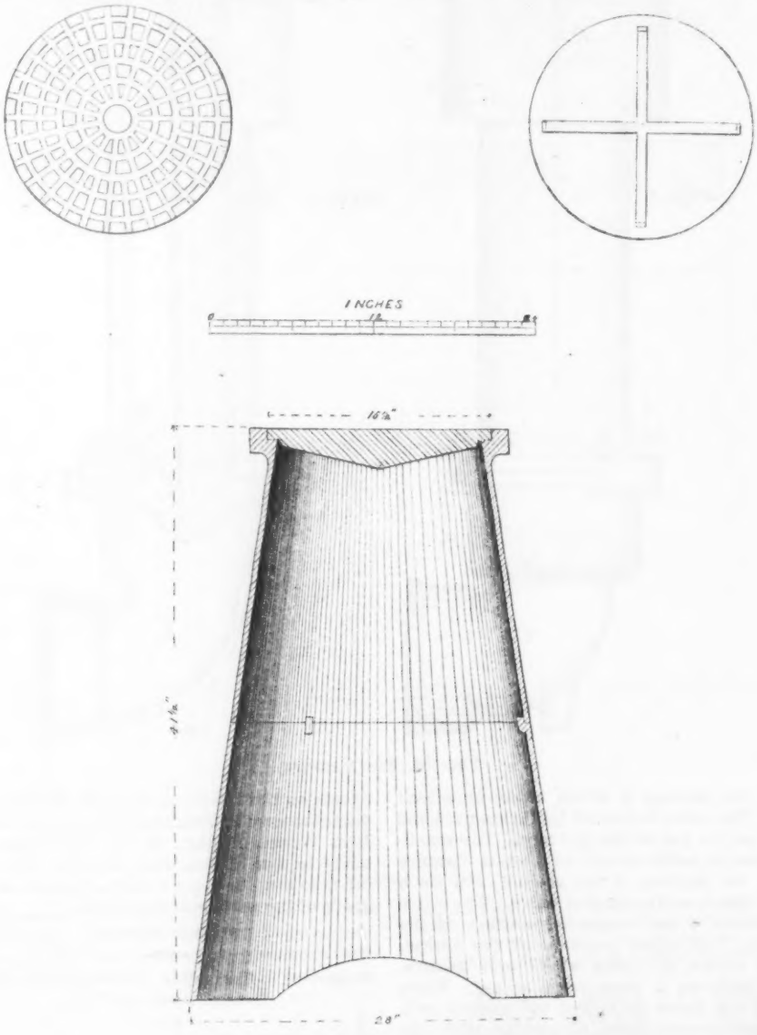

Plate 18. Stop-Valve Box. (See page 197.)

This looseness is particularly objectionable in a leveling instrument or in a transit used to measure vertical angles. The best instruments have a split nut with a clamp-screw by which to adjust for wear.

Some instruments are provided with an arrangement for approximately leveling the instrument very quickly without manipulating the foot-screws. This device is especially suitable for leveling instruments; but, by using a little care in setting the tripod, it can be dispensed with easily. All such additions are an advantage in the greater convenience, and a disadvantage in the increased weight, complexity, and cost.

4. Graduation.—The lines of the graduation should be uniform, and as small as possible and still be legible. In the best instruments the graduation is upon solid silver.

The most common graduation for the horizontal circle of engineers' transits, is a circle about 6 inches in diameter divided to one-half degrees with a vernier reading to minutes. The degrees are usually numbered in two rows, one like the compass and another from 0° to 360° The field work is most simple and least liable to error, if only the latter numbering is used. See remarks on the transit verniers in Art. III of this series.

The verniers on the horizontal circle are sometimes placed 90° from the line of sight, in which case the observer must change his place between sighting the telescope and reading the vernier; sometimes the verniers are placed immediately under the telescope, in which case the observer can read the vernier and sight the telescope without changing his position, although the telescope must be revolved before the vernier can be read. The latter position is preferable, especially in confined positions as in underground surveying, etc. An intermediate position would be still better. For convenience of reference, the verniers should have some distinguishing mark, say *A. B. C.* etc., upon their faces.

5. Centers or Vertical Axes.—Usually there are two concentric vertical axes, the verniers, telescope, etc., turning about the inner, and the graduation revolving about the outer one. As ordinarily used, the outer axis is useful only in enabling the observer to shift the graduation so as to begin each time at zero. The inner one is made more carefully than the outer. These two axes are often called "centers" and sometimes "compound

centers." For work not requiring great accuracy, but demanding a light portable instrument; these axes are made quite short and are called "flat centers." The more accurate instruments have "long centers."

6. TANGENT SCREWS.—With the unaided hand the telescope cannot easily be made to cover or bisect the exact point sighted at; to assist in thus directing the telescope, the instrument is provided with a clamp and tangent or slow motion screw.

Clamps are made in a variety of ways, but all consist essentially of a contrivance by which a piece may be connected with the axis or rim of the graduation by simply tightening a screw. The clamp is connected with the vernier plate or the tripod, as the case may be, by a screw which is always nearly tangent to the direction of motion. When the screw is turned, the two parts of the instrument rotate slowly with reference to each other. No description can give an adequate understanding of these parts; they must be seen and examined to be comprehended.

A perfect tangent screw should have a very smooth motion, free from lost motion or "back lash," a great durability and an even wear so that the screw will never have lost motion in one part and move hard in another. Lost motion is the common defect of tangent screws and also the source of great annoyance to the engineer, besides often being the cause of serious errors in the field. Several forms of tangent screws will now be described.

The oldest and most imperfect of all is that known as the English or stiff tangent screw, in which the screw works through a post in the clamp and against a collar in a post attached to the plate, both parts being free to turn about a vertical axis. The defects of this form of construction, are, 1, if the screw is not perfectly straight and true, it will bind during one part of the revolution; 2, the nut and collar should be the same height above the plate, and to allow for errors of workmanship, the hole in the nut is often made too large and then tightened until it fits, thus touching in only two points, and therefore soon wears loose; and 3, the parts are so arranged that, if the movements are adjusted so as to prevent looseness, the friction will be so great as to interfere with the freedom of the motion.

Another form has a long spiral spring between a collar on the screw and the nut, which takes up the back lash. On trial this has proved defective since the spring must be made long enough and strong enough to act in every portion of the length of the screw, and the alternate opening and closing weakens it so that in a short time it fails to remove the back play.

Another form, which has the same objections, allows the screw to abut against the clamp, a spring keeping the clamp in contact with the screw, Even under the most favorable conditions, tangent movements of this class are objectionable, because the spring causes a strain between the parts which may change with changes of temperature and which is liable to cause motion or derange the levels.

One of the best forms of tangent screws is that commonly known as the Gambey tangent movement, first made by the celebrated instrument maker, Gambey, of Paris. As commonly made, the nut is a split sphere which is confined like any ball joint. Instead of the collar, as in the English form, another split spherical nut, with a thread of a different pitch, is used. This construction provides for all necessary motions and all probable imperfections of the screw. The only objection to this form is that, since the nut is short the screw will wear most near the middle, and when the nut is tightened to remove the lost motion from the small part of the screw, it will work too hard on portions less worn, therefore, the screw can be turned only a few revolutions without having lost motion in one part or a great friction in another.

In the genuine Gambey tangent movement, the halves of the spherical nuts are confined between springs; consequently, it does not possess the above defect, and is all that could be desired.

The latest tangent movement is an improvement of the counterfeit Gambey. It consists of "a long spiral cylinder nut, from the interior of which two-thirds of the threads have been removed; into half the recess thus left in the nut is nicely fitted a cylinder follower, with the same length of screw thread as the nut, this follower is fitted with a key, which prevents it from turning in the recess, but allows motion in the direction of its length. A strong spiral spring is placed in the remaining half of the recess, between the fixed nut and the movable follower: this spring always has tension enough to force the follower and fixed thread in contrary directions, and thus remove any lost motion that may occur in the screw. It will be observed that with this construction the spring remains in a state of rest, instead of closing and opening, as has been the case in all other application of springs." The spiral spring takes up the wear of the screw, and the great length of the nut secures nearly uniform wear over the whole screw. These long nuts may be confined like any ball joint, or may be attached by gimballs, thereby allowing free motion even though the screw should not be straight.

Sometimes two opposing or butting screws are used to get rid of lost motion; but these are objectionable since two hands must be employed in using them. For several reasons they are not at all suitable for the upper motion, but on account of their steadiness are often used for the lower motion. If a stiff, flat spring were attached to the side of the lug against which the tangent screw bears, the setting could be finished with one screw. Such a spring is a very useful addition.

7. The magnifying power of the telescope and the least count of the vernier should be proportioned to each other, so that the least perceptible movement of the vernier will cause sufficient motion of the cross hairs on the object to be easily noticed through the telescope; and *vice versa*, the least noticable motion of the cross-hairs on the object should cause a perceptible change of the vernier. Since the horizontal circle is usually (and properly) the more accurate, this condition applies more especially to the horizontal circle than to the vertical. A higher power, or a smaller count of the vernier, than required by the above conditions, is detrimental, the former causes an unnecessary loss of light; and the latter a waste of time in reading the vernier. A similar relation should exist between the magnification and the level under the telescope, and also between the magnification and the plate levels. Many instruments are very faulty in some or all of these particulars.

8. An engineer should have a good instrument and then take delight in keeping it in good condition. It is not desirable to take the instrument apart unnecessarily, for even if the fittings are perfect, it requires considerable care to put them together properly. A little dust or dirt in a joint or bearing, or a screw left loose or tightened too hard, may damage the instrument and cause errors in its use.

There are a great many small screws about a transit and the general tendency is to overstrain them, This is especially true of the cross-hair screws; all straining of these screws, beyond that necessary to insure a firm seat is more apt to cause the instrument to lose than retain the adjustment. Over straining the leveling screws bends the plates and wears the screws unnecessarily. If the leveling or tangent screws get to working hard, take them out and brush with soap and water; the nuts can be cleaned by screwing a thin piece of soft wood through them. The tangent screws are only intended to complete the settings; they should never be used except to give a slight movement.

The telescope slide and the center should be examined occasionally; if there is any fretting or cutting, take the piece out and burnish down the rough place with any smooth hard tool, as the back of the blade of a pocket-knife. Very little, if any, oil or grease should be used upon bearings exposed to the dust; probably powdered plumbago is best for exposed bearings, and rendered o.-marrow, or watch oil, for bearings not exposed.

TO BE CONTINUED.

Cleaning Tracing Cloth.

In response to our suggestion in the last issue of ENGINEERING NEWS, under the above heading Mr. E. V. Clemens, M. E., of Ansonia, Conn., contributes as follows:

He says that he has used pulverized quartz in a manner similar to that stated by ourselves; and further remarks that a drop or two of ox or nut gall in the ink obviates all difficulties and saves time and possible "fracture of the commandments."

In this connection we might mention the changes brought about in the use of tracing linen by the introduction of the blue-copying process. Nearly all tracing linen is now made dull-back, and in many of the larger railroad offices and bridge-works, strain sheets, detail drawings, etc., are made with pencil directly upon the dull back and finally inked in. This practice is labor-saving, as it obviates the subsequent tracing of a drawing made first on thick Whatman paper, and by the blue-process any requisite number of copies can be made from the original always on file. The dull-back permits working with pencil almost as readily as paper simply by stretching it over a white paper surface on the drawing-board. For strain diagrams a thin white drawing paper is also used with dense black India-ink; from which blue-prints can be directly made by the usual process.

Tests of American Portland Cement in Europe.

About a year ago Mr. Thomas C. McCollom, of the Committee on Cement Tests of the American Society of Civil Engineers, sent a sample of "Giant" Portland Cement manufactured at Egypt, Pa., to Mr. Henry Faija, the leading English authority on cement, for the purpose of having it tested in the latter's cement testing rooms and laboratory, in comparison with the English and Continental brands. Under date of September 18, 1885, Mr. Faija reported the residue on a No. 70 sieve to be 4 per cent., and on a No. 50, 0.75 per cent., and the seven days tensile strain per square inch to be 554 pounds. In summing up he said: "It is a slow-setting cement and well ground. It is, in my opinion, a perfectly safe and sound cement to use and freely to acquire considerable strength." A short time ago, the year having gone by, Mr. Faija again reported the following results at long periods and a summary of his tests:

	3 days.	7 days.	28 days.	3 mths	6 mths	9 mths	12 mths
No. 1 broke at	320	450	580	650	610	740	750
" 2 "	335	460	490	550	720	740	800
" 3 "	370	450	520	600	760	780	790
" 4 "	290	450	540	700	780	820	760
" 5 "	300	460	570	720	330	770	820
Average	321	454	540	644	740	770	754

"The briquettes were in all instances gauged and treated in a similar manner to those described in my report under date September 18, 1885, and were broken respectively at the periods mentioned after gauging and gave the results shown. They corroborate my report of September 18, 1885.

"There is no doubt that it is a very good cement and certainly deserves to have a good sale. It seems to me quite equal to many of our cements here."

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Subscribers who wish to have complete files of this year's numbers of ENGINEERING NEWS *must make application at once for missing numbers or to replace mutilated copies. We will give one month's subscription for each copy of Nos.* 13 *and* 14 *of this year, uninjured, mailed to us during October. In wrapping cover the whole length of the paper, otherwise they arrive with torn leaves and we will not accept them.*

WE commence this week the publication of a series of papers embodying the final report of Her Majesty's Commissioners on Accidents in Mines and the possible means of preventing their occurrence and limiting their disastrous consequences.

This report, which is just published in England as a Parliamentary document, is the result of a most conscientious study of the subject extending over years, and is the latest, and consequently the best, treatise upon this important branch of engineering.

While it was intended originally to refer especially to coal-mining, the deductions drawn and methods proposed will apply as well to any other mine or to tunnel work in many points. And as the edition is limited and the work already scarce we propose to publish all that is useful to American miners.

SEVERAL correspondents find fault with our late remarks on cast-iron *vs.* wrought-iron water pipe, and say that we unjustly condemn the cement-lined and other cheap forms of pipe for water carriage.

We would only say that we are open to conviction, and that the pages of this journal are free to any one who will argue the matter from a standpoint of intelligent experience in the manufacture and use of any form of water-pipe. We do not deny that cement-lined pipe has been sucessfully employed at several points and has been used for some years. But the point that we wished to make is that the manufacture and laying of this character of pipe is attended with great risk; or, in other words, a class of material, workmanship and supervision is demanded that can rarely be secured in ordinary contract work.

As bits of practical experience in the use of cement-lined pipe, we would quote from the last report of the Water Commissioners of Hartford, Conn. In that city fifteen miles of cement-lined pipe are yet in use, but the engineer speaks of it as "causing much trouble" by frequent breaks whereby the streets are damaged and the city involved in heavy expenses for repairs. The engineer also recommends the replacing of all this pipe with cast-iron, at a cost *exceeding one hundred thousand dollars.* Norwich, Conn., has practically had a similar experience with its cement water pipes; breaks have been frequent and the engineer is also replacing the compound pipe with cast-iron. In this latter town a new danger has developed itself in the shape of lightning; in 1884, the cement main was struck by lightning four different times and 1,446 lineal feet of it damaged.

The above and similar reports from other localities impelled us to write as we did. But at the same time we will be happy to publish any matter that will throw further light on the subject of cement-lined pipe; provided only, that the author enters into a full detail of the materials and methods used, pressure applied, length of service and the actual cost.

MR. JEANS suggestions for the better future management of English railways are generally sound in the light of American experience; and they are timely in view of the present decline in their value as dividend payers, as shown by the report of the Board of Trade elsewhere given.

But we would suggest, that while Mr. Jeans is advocating what is practically a very radical change in administration, that he go still further and introduce machinery and rolling stock of the American type. This would mean expensive outlay in adapting engine-houses, turntables, bridges, etc., to the heavier and longer engines in use here, but it would ultimately pay roundly.

IN the paper on girder construction, referred to elsewhere, as lately read before the British Association we notice that the engineers present carefully ignored several points which the authors seemed especially anxious to bring to the "consideration of English engineers." These were, the relative economy of depth of girder and pin *vs.* rivetted connections.

Prof. Smith gracefully admits the greater facility afforded to the "office" calculator by pin connections. And well he might; it has puzzled the best of American engineers to trace the bewildering vagaries of stresses in many an English rivetted connection; and we feel assured that the engineers are very few indeed in the United Kingdom who can, for example, make a strain diagram for the skew-back connections of the Forth Bridge—and swear to it. In point of behavior, too, at the joints, we should say that pins had a decided advantage over rivets, if our present knowledge of the law of shear is of any account.

The economical value of a proper proportion of depth to span in a bridge girder is too evident to admit of discussion; and it is only remarkable that it has not earlier been applied to English bridge practice.

Mr. Head delivered a blow from the shoulder when he referred to the Hawkesbury bridge. In the international competition over that structure, it was not a question of material, for English iron and steel are to be used. It was the best and most economical design for accomplishing certain ends under difficult circumstances that won the day. And it is just under such conditions that American engineers succeed. As Sir Joseph Banks, in 1786, wrote to Thomas Paine regarding his iron bridge design, "Americans think with vigor and are not fettered with the trammels of science." In other words, in each new problem, they throw aside all tradition and sweep out a course that seems best adapted to the controlling conditions of locality and material. If our English brethren would forget what their fathers did, they would make money by the operation.

The suggestion that engineers and the builders of bridge structures go hand in hand in extending a common research into the behavior of material, is a good one. Theory is very good, but it must be tested by practice to be valuable; and the practical knowledge of the manufacturer can be made of the utmost use to the engineer. The practical man may meet with difficulties, or perhaps stumble upon combinations, that the purely theoretical man would never dream of, with all his philosophy.

Why Is This?

The supplementary paper on "English and American Railroads Compared," by Edward Bates Dorsey, read at the Annual Convention of the American Society of Civil Engineers, at Denver, last July, contains such astonishing figures as to the comparative cost of some items of operating expenses on English and American railroads, that we give below one of his tables and concluding remarks in full, viz:

TABLE No. 49.

Comparative Cost of Transporting one Ton, or one Passenger, one mile, in Maintenance of Way and Motive Power.

No Reports for 1885 from the London and North Western have been received.	London and North Western. Average of Years. 1883 and 1884.	Pennsylvania Railroad Division. Average of Years. 1883, 1884 & 1885.
Maintenance of way	.206 cent.	.100 cent.
Motive power	.266 "	.147 "
Total	.472 cent.	.247 cent.
	.247 "	
Excess of Cost	.225 cent.	

This excess is more than half of the total cost of all operating expenses of the Pennsylvania Railroad in 1885.

It cannot be said that the Pennsylvania Railroad has favored to any serious extent these two accounts at the expense of others, as the total cost of all operating expenses in 1885 was less than the aggregate of these two items on the London and North Western.

If this amount could be saved, it would, on the traffic of the London and North Western Railway, amount to an annual saving of about ($5,000,000) five millions of dollars. This estimate is based upon the prices actually paid. This saving would be still more largely increased if proper allowances were made for the difference in the price of labor and material, used on the two railroads.

I conclude this paper with the last sentence in my first paper on this subject.

"For what *is* done in the United States, *ought* to be done in the United Kingdom."

Mr. Dorsey says: "Each of these roads may truly be said to be the most perfect and extensive of their respective types."

Can our English contemporaries explain this great difference in cost?

In our opinion it is caused largely by the superiority of the American locomotive and other rolling stock. It runs with less friction and also with less wear and tear on itself and on the rails and road bed, and the locomotive also does more work with half the cost for repairs and renewals.

A Matter of Nomenclature.

Our contemporary, the *Sanitary Engineer*, in an article on "Tests of Material for the Electric Subways," made what seemed to us, on reading it, a rather unnecessary point, *i. e.*, "the word concrete belongs properly to mixtures of lime or hydraulic cement, and the word mastic is the proper one to use where hydro-carbons are the cementing material," as we thought no one but those connected with the old coal tar paving industry used the term concrete to specify a substance in which the cementing material is a hydro-carbon. But we are pained to see *Science* dropping into the above mentioned misuse of English in describing the electric subways.

A mistiness as to the meaning of technical terms not only interferes with scientific research, but also with industrial results, and we do not know of any class that have done more to confound the technical terms they used than the coal tar pavers of this and other countries. On their start, having a rather indistinct knowledge that superior pavements were being laid in Paris with asphalte, they promptly discarded the honest name of the material used, coal tar, and called it asphalt or asphaltum, maintaining that as the latter substance was bituminous according to lexicographers and encyclopedia makers, and as by the same authorities coal tar was also bituminous; hence it followed, that coal tar must be asphaltum or asphalte; at any rate, asphalte was undeniably the best, and however poor their plaster was to be, they determined its name at least should be good.

As instances of the confusion that has grown out of this misuse of terms, we may site the absurdity of coal tar concrete, which has been transformed into asphaltic concrete, and the quickly constructed and satisfactory formation of the great Creusot 100-ton hammer at the Paris Exposition, is referred to as authority for the use of a mixture of coal tar, sand and broken stone! And we are informed that an engineer or architect who specifies a covering of asphaltum for a cellar floor or arch, is liable to have a mixture of three parts coal tar, and one of bitumen palmed off on him, without legal redress. It is possible the abuse has gone so far that it cannot be redressed and it will always be necessary to specify Trinidad or other bitumen, or rock asphalte when such substances are desired, but it seems to us that technical and scientific journals should not allow a loose, if not worse, system of nomenclature to be used on their pages.

Slack Burning Locomotives on the Union Pacific Railroad.

From the commencement of coal mining operations on the Union Pacific coal-slack has given trouble, both from its quantity and from the fact that most of the mines are below the level of the track, the space required for this waste product has led to the practice of burning the heaps, which has required attention and supervision.

These difficulties have at length led the company to procure a Wootton locomotive, the experiments with which, according to the *Salt Lake Tribune*, have been so satisfactory that the company will probably equip their road with locomotives of this pattern and use coal slack exclusively for firing them, saving the merchantable output of their mines for commercial consumption.

Progress Report on the Geodetic Triangulation of Pennsylvania.

We make the following extracts from the progress report of Prof. Mansfield Merriman, Act. Asst. U. S. Coast and Geodetic Survey, relating to the work in Pennsylvania:

Prof. Merriman first very clearly explains the nature of a geodetic triangulation, describes the methods used in actual practice, and then gives the progress made in Pennsylvania.

During the past twelve years Congress has appropriated annually a sum of money "for furnishing points for State Surveys" by the extension of the triangulation of the U. S. Coast and Geodetic Survey. The appropriation for the past few years has only been $16,000, applied to a number of States, and previous to 1885 the average proportion falling to Pennsylvania was about $1,600, only sufficient to keep a single party in the field for two or three months each year and the progress has thus been slow.

In 1875, this work was commenced under Prof. L. M. Haupt and a series of triangles was determined upon; this reconnoisance was continued in 1876, and work begun with six tripods and four stations established for the measurement of angles. During 1877 there were no funds available, but in 1878 Prof. Haupt was again at work and made a connection with the primary triangulation of the coast. At the close of 1880 Prof. Haupt resigned his charge and was succeeded by Prof. Merriman, and in 1882 the latter closed the connection of a horse-shoe chain of triangles between the primary line, from the north boundary of Delaware to points a few miles north of Trenton, N. J. As showing the accuracy of this work when compared with the coast triangulation, the descrepancy in a line 21,153.07 meters long, was only 3 centimeters; the latitude of Newtown checked within 0.103", and the longitude of the same place within 0.060". This agreement is very satisfactory when we considered that the distance between the two fixed lines used as bases, is nearly 150 miles when measured along the center of the horse-shoe chain.

In 1885, a larger sum than usual was appropriated for the purpose of extending the triangulation northward over the anthracite coal regions to meet the needs of the Second Geological Survey of Pennsylvania, and westward to the Susquehanna.

As indicated on the map accompanying the report, the eastern end of the State is well covered by measured triangles, from the Delaware line north to near Tunkhannock on the Delaware river, and westward as far as Harrisburg; the Lake Erie triangles have also been measured where those waters touch the State. Reconnoisance has been made and triangles located but not measured, along the entire southern tier of counties nearly to the West Virginia line, and northward to the New York State line along the line of the Delaware river.

The unit of distance used in this survey is the "meter," and the following constants are adapted:

Meters × 3.280869 = feet.
Meters × 0.000621377 = miles.

The report gives the latitude and longitude of a number of points in Pennsylvania, along with the azimuth and distance between stations used.

Is the Pennsylvania Petroleum Supply Diminishing?

The future oil production of the Pennsylvania region is being carefully investigated by the geologists of that State and present data seems to point to a decline in the volume of product. Mr. Ashburner, of the Pennsylvania State Geological Survey, shows that in 1883 there were 17,100 wells with an average daily production of 3.8 barrels each, a total of 64,600 barrels; while in 1885 there were 22,524 wells averaging 2.5 barrels each, or in all 56,310 per day.

Prof. Lesley, the State Geologist, also refers to petroleum in Pennsylvania as a "vanishing phenomenon" at a recent meeting of the Institute of Mining Engineers at Pittsburg, and predicted that people now living would drain its dregs.

However this may be, the marketing of oil is well kept up if we take the Government Statistical Bureau as authority. According to this document, the exportation of petroleum, for the year ending June 30, 1885, equalled 571,483,375 gallons, and the value of the same was $49,478,649. If we estimate 1.50 per cent. of the above quantity as an equivalent of the home consumption, we have a further production of 857,225,062 gallons, valued at $74,207,973. On this basis the total American output for 1885 would have been 1,428,708,437 gallons of a gross valuation, for foreign and domestic trade, of $123,685,622.

But in the same period covered by the above statement, the entire yield of the New York, Pennsylvania and Ohio oil fields was only 1,132,687,710 gallons and a consequent pretty heavy draft must have been made on accumulated stock.

American Bridges before the British Association.

At the fifty-sixth annual meeting of the British Association, at Birmingham, England, the subject of girder bridges was brought up by a paper read by Messrs. W. Shelford and A. H. Shield, both members of the Institution of Civil Engineers. The subject matter of the paper, and the discussion are interesting to American bridge builders and American engineers generally.

The paper was pertinently entitled "Some Points for consideration of English Engineers with Reference to the Design of Girder Bridges." The authors commenced by pointing out that a comparison of English, German and American bridges, more espcially with reference to work intended for newly developed countries, afforded sufficient grounds for the examination of the present English practice. The paper was confined to moderate spans, and compared typical designs of 140 feet span. In good designs of the same depth of truss the difference in weight was small comparatively; but the principle that economy is obtained by increasing the depth had not yet found expression in the practice of British engineers.

In comparing the relative advantages of American and English designs, the latter have undoubted security, but are lacking in economy of material. To remedy this defect the authors suggested the publication of details of comparative cost of different modes of construction, and the adoption of standard sections for rolled iron.

The influence of the Board of Trade rules is strongly felt in English practice; these rules would permit for wrought-iron and steel

maximum working stresses of five tons and six and one-half tons per square inch, without the stipulation of a defined strength of material. The first defined rule for the strength of iron railway bridges was applied to cast-iron structures, and required a safety factor of six for the moving load. A misapprehension as to its applicability to wrought-iron structures lead to the introduction of five tons per square inch as the proper strain, and this was supposed to represent a safety factor of four, by Sir Henry Tyler, for both fixed and moving load. The present rule for steel was introduced by the Board of Trade in 1877.

The scientific and commercial interests of engineering call for a new series of rules more in conformity with the modern knowledge of the properties of materials, and the laws of construction. The authors suggested a new series of rules to be adopted by the Board of Trade. The rules are framed so as to leave the engineer free in the choice of design and material, and leaving to him the estimation of all the effects of loading, which can be determined by known methods. These rules, however, should provide co-efficients of safety separately for each of the effects usually covered by an arbitrary factor of safety.

Mr. Wm. Anderson, in discussing this paper, said that years ago in designing bridges for Ireland he had adopted standard forms and sizes with great advantage. In this respect American constructors have the advantage. He thought that steel was yet too treacherous a material when worked into plates, to make safe any present reduction in working stresses.

Prof. R. Smith thought that the American pin connection had an "office advantage" in making calculation lighter, but there was a greater distance between joints; and in rivetted joints the stresses were better distributed and the joints were the weak parts. He admitted that the greater stiffness of a rivetted joint was a disadvantage, but thought that the state of mechanical knowledge was not yet sufficiently advanced to settle that point.

Mr. Jeremiah Head remarked that Canada now obtained its bridges in the United States, and an American firm had lately obtained a contract for a large colonial bridge. The latter bridge however was sublet, in great part, to English manufacturers and was to be made entirely of British material. He thought this last point proved conclusively that there was something wrong in the English way of going to work. Among other things he would like to see English contractors of position a little more consulted and less ignored by engineers. He noted the extraordinary differences observable in specified tests emanating from different engineer's offices, and thought from this fact that knowledge was not yet so complete as to permit a disregard of any tests from other practical sources. To meet the requirements of Lloyd's Registry and the Board of Trade, steel must be made by the Siemens-acid process with ore brought from Spain, because English ore does not lend itself to this process. He thought the rule should be relaxed so as to admit of the use of home ore, as an excellent material could thus be made which though it would not quite stand the full test required would build very good ships.

Sir Frederick Bramwell was not at all in accord with Mr. Head in that manufacturers should suggest tests. Engineers had ends beyond cheap production; and he illustrated his position by saying that the French made a steel projectile which had accomplished on English soil results never reached by an English projectile.

The present Board of Trade rules are based on a report of a committee of the Institution of Civil Engineers, and Mr. Beaumont felt that the time had arrived for the appointment of another committee to revise these rules.

The paper immediately following this was one on the "Louisville and Albany Bridge, over the Ohio River; presented by T. C. Clarke and Chas. Macdonald of the Union Bridge Co., New York. Apparently no notice whatever was taken of this American structure, at least by public discussion.

English Railway Administration.

Mr. J. S. Jeans, at the Birmingham meeting of the British Association, read a paper on "Some Economic Defects of the English Railway Administrations."

He said that the average capital outlay per mile of line in the United Kingdom rose from £35,900 in 1872 to £42,500 in 1885; during which interval 3,553 miles of new line had been opened, at a capital expenditure of £247,000,000, or £73,000 per mile. Between 1862 and 1872, 6,263 miles of new line cost only £43,000 per mile as figured on increase of capital.

Mr. Jeans thought the chief sources of increased outlay on existing lines were in additional terminal and other facilities for traffic and remarked that it is time for the British public to check this prodigal expenditure on old lines. English roads, in comparison with length, had command of the largest volume of traffic of any system in the world and should be worked to produce higher rates of dividends.

The author thought English railways were going from "bad to worse," and charges much if not all of this trouble to very defective administration. He suggests as a means of securing greater economy in the future:—Slower speed for goods trains; a reduction of dead as compared with paying load; the use of heavier loads, or the running of fewer empty cars; the abolition of duplicate trains between common termini; the transfer of a great portion of the heavy traffic, to canals, or an increase in special lines for that traffic, and finally the publication of railway accounts in such manner that the cost and profit of the ton per train mile could be ascertained.

Notes on the Panama Canal.

Charles D. Jameson has read before the Boston Society of Civil Engineers a very practical paper upon the Panama Canal, and as coming from an American civil engineer we make the following abstract:—

Mr. Jameson commences with a historical sketch of the various interoceanic canal projects, and pays a high compliment to the indomitable energy of Count de Lesseps, who alone could have gained the unbounded confidence of the French in the ultimate success of the canal, and obtained unlimited credit for the enterprise.

After describing the general route of the canal, as already detailed in full in this journal at various times, the author proceeds to treat of the administration on the Isthmus. Besides the Director General, Assistant Director General, Chief Secretary and Chief Engineer, there are about 700 other "chiefs" of various grades; during the five years of construction, there have been eight different administrations, no one lasting two years; this constant change of head of course resulting in great loss to the Canal Company. The City of Colon (Aspinwall) is without drainage of any sort, and owing to the fact that refuse of all kinds is thrown into the streets and on vacant lots, the unhealthy nature of the spot may be ascribed to this feature quite as much as to the general climate; excessive brandy-drinking also adds to the death-rate. The company's camp, however, of eighty-five acres at Colon, and the camps of each section along the canal, are drained, paved and kept exquisitely clean without regard to expense. This feature, which is generally regarded as a waste of money, is justifiable from the beneficial results arising from it in such a climate. The death-rate in Aspinwall is enormous; but the death-rate in the Canal camp, a part of the same city, was from June, 1884, to June, 1885 only four in a total population, of 600, and two of these were the direct result of intemperance. It must be admitted that the Canal Company, with all its sins of omission and commission, takes good care of the health of its employés. The two main hospitals, with 500 beds, at Colon and Tobago, are nearly perfect in their arrangements and all employés of the company are admittted free of charge on a doctor's certificate. Contractor's employés pay $1.00 per day, or $2.00 per day for a private room including care and food. Mr. Jameson says that no one can deny that the management on the Isthmus has been very loose and very badly directed, and a tremendous amount of money has been spent for which no result can be shown. As a general rule the employés of the company feel no interest in the work beyond the regular drawing of a monthly salary; owing to the unhealthy climate and consequent uncertainty of life, the one idea on the Isthmus seems to be, "get what you can, how you can, as quick as you can, and get out of the country."

The main offices of the company are in Panama in one large building, in which 400 or 500 men are at work. The Director General has a salary of $100,000 and all expenses paid of every character. With the exception of six or eight other important positions, ranging from $10,000 to $25,000 per annum, the salaries paid by the company are by no means high considering the country and the prevailing rates of wages paid by other companies in the same region.

The line of the canal is divided into sections of about six miles each; and the engineer in charge of a section receives from $200 to $250 per month and $2.00 per day for expenses; the assistant chief of a section receives $150 per month and expenses, and the instrument men and draughtsmen from $60 to $100 per month and expenses, which latter falls to $1.50 per day in the lower grades. The headquarters provided are comfortable and airy. The company gives six months' vacation on full pay for each two consecutive years employment, with expenses paid to any part of the world and return. Few, however, have been entitled to this vacation, and these few generally prefer to continue work and have the equivalent money put to their credit.

The climate, like all tropical countries near the sea level, is most unhealthy. The prevalent diseases are dysentery, malarial and yellow fever. The nights, however, are cool enough to sleep well, and in the shade during the day the heat is never oppressive.

With regard to the labor, the higher positions are mostly filled by Frenchmen; the chiefs of sections are all French, and the clerks, under secretaries, store keepers, etc., are mostly Jamaica and Martinique negroes who have a fair common school education. The percentages of laborers as to nationalities are about as follows:

Greeks and Italians	.10
English, Americans, Swedes	.06
Germans	.04
Colombians	.20
Jamaica and Martinique negroes	.60

Among these the Greeks are the best and most intelligent workmen, but they are much addicted to drinking and gambling, are quarrelsome and ready to use a knife, and can in no way be depended upon. The Swedes are faithful but stupid; the English and Ameri-

cans among the laborers are the very scum of the earth, usually runaway sailors. The native Colombians are of Indian or Spanish-Indian blood; they are a straight well-built people, but are lazy and indolent; they are best adapted to clearing the right-of-way. The main body of laborers comes from Jamaica, whence they are imported under contract at the rate of about 1,000 per month, for two months at a time, at $1.50 per day. They are utilized not because they are good workmen but because they are more abundant than any other nationality; Chinamen are only found as small merchants along the line. The laborers work from 7 to 11 A. M., and from 2 to 6 P. M. The clerks and office men work from 8 to 11 A. M. and from 2 to 5 P. M. There is no night work and no Sunday work.

Most of the actual work done upon the line has been done by contract, the tools and necessary machinery being furnished by the company. The contractor give bonds for 10 per cent. of the amount of his contract and pays 7 per cent. of the cost of his tools for their use.

During the last three years the great object of the administration has been to make a showing in the amount of material removed; and hence large contracts, up to one year ago were made on terms very favorable to the contractors; provided he pushed work he practically made his own conditions. In these contracts the company provided tools, paid for delay in the non-delivery of tools on time and extra expenses for idle gangs, locomotives and excavators. Owing to the "red-tape" of the storehouse service, a judicious contractor usually had a monthly estimate of damages due him which exceeded by two or three times the amount due for actual work. As an extreme example, on one of the largest contracts, the contract price per cubic metre excavated, was "we will say three cents;" at the end of the year the amount actually paid the contractors divided by the actual cube extracted made the cost to the company "17 cents in place of 3 cents." Common labor was paid from $1.50 to $3.00 per day; skilled labor, such as machinists, etc., $5.00 to $10.00 per day.

The administration of the storehouses is bad, they are packed with everything one can imagine, and most of the articles in ridiculous quantities; as for example at one time 600 anchors of the same size and make were unloaded and packed away at Colon. To get anything from a storehouse, you must first hunt around and find where it is, then get an order from the Director General and finally go and get it yourself.

The machinery on the main line of the Panama Railroad is American and English, but all the engines in the canal yards and cuttings are French or Belgian. The dump cars are English, American and French make. The steam shovel most used and the one giving greatest satisfaction is the Osgood & McNaughton, of Albany, N. Y. The Hercules Dredger, illustrated and described first in ENGINEERING NEWS, is also described and highly commended. There are seven of these dredges now at work and the average output in January last was 104,000 cubic metres per dredge. This American company up to January 31, 1886, had excavated more than one-third of the whole amount of work done on the Isthmus.

The Chagres river crosses the canal line twenty-seven times and in its upper course is from 100 to 150 feet above the bed of the canal; in June, 1883, this river rose 44 feet in four hours at San Pablo. The plan adopted for disposing of this troublesome stream is to carry the river in canals parallel to the ship canal and protecting the latter by heavy masonry where the two lines come in dangerous proximity. The Chagres is to be further controlled by building a dam three-fourths of a mile long, 150 feet high and with a base of 1,300 feet, between the Santa Cruz and Obispo mountains near Matachin; the exterior slope will be four to one of broken rock. Through the Azul mountain, to the left of Santa Cruz, a tunnel will be driven 600 metres long and 7 metres in diameter through which the waters of the Chagres will be passed. These works are intended to regulate the flow and store the storm water.

Mr. Jameson gives the total amount of work done to January 31, 1886, at 15,000,000, cubic metres, leaving a balance of 107,000,000 to be done in the canal proper, not including the rectification of the Chagres and Rio Grande rivers and the improvement of the Colon harbor. He puts the approximate expenditures to the same date at $107,000,000, divided as follows:—

Excavation	$30,000,000
Houses, land and clearing, etc.	5,000,000
Machinery, materials, etc.	36,000,000
Administration in Paris and on the Isthmus, expenses of organization, etc.	29,000,000
Cash on hand	7,000,000
Total	$107,000,000

To raise this money the liabilities of the company are $150,000,000, on which the company now pays, at 4 per cent., $6,000,000 annual interest. The above statement does not include the $17,000,000 to be paid for the Panama Railroad.

Though any such estimate must be purely conjectural, the author approximately estimates the cost of finishing the canal in "eight years" as follows:—

Excavation, 107,000,000 c. m. at $1.50	$160,500,000
Chagres river and harbor	40,000,000
Administration	3,000,000
Total	$203,500,000
Banking and interest for eight years	80,000,000
	$283,500,000
Annual interest at 4 per cent. on $283,500,000	$11,340,000
Interest on money already raised	6,000,000
Annual interest when finished	$17,340,000

The company can only charge $3 per ton for saving ships 8,000 miles of distance, and the annual tonnage is variously estimated from three to eight millions; the real tonnage must be guessed at at this time. The revenue of the Suez Canal grew from $900,000 in the first year to $7,500,000 annually in the first ten years, and is now $12,000,000 annually.

Mr. Jameson closes by saying "there are no unsurmountable obstacles in the way of completing the Panama Canal in a few years. The only question is money, and certainly as long as de Lesseps lives there will be no lack of that. The management on the Isthmus has been loose and disjointed, but it is improving rapidly now. Undoubtedly money has been wasted, but no greater percentage than in other large enterprises. The work is being pushed in every direction. Contractors are being held to their contracts, and although no one can state the time when the canal will be finished, still no one can advance any proof or reason why it cannot be finished within the next eight years."

The Working of English Railways for 1885.

The Board of Trade of England has issued its reports upon the working of English railways for 1885 as a Parliamentary paper. We make from it the following abstract:—

There has been a further decrease in net earnings and dividends, and some diminution in working expenses as an offset. There is again an increase in the capital invested to the extent of £14,394,000. This is less than in 1884 when the capital increase was over £16,000,000, and in 1882 it was £22,000,000. The Board, however, thinks that the present increase of 1.8 per cent. is too much.

The proportions of the different descriptions of capital remain the same as for the last seven years. These are: Ordinary, 37 per cent.; guaranteed and preferential, 38 per cent.; loans and debenture stock, 25 per cent. The present amounts, in the above order, are: £302,000,000; £308,000,000; £205,000,000; total, £815,000,000 ($4,075,000,000).

In traffic receipts there is a total decrease of £900,000; made up of a decrease of £800,000 in goods traffic and £200,000 in passengers, but there was an increase of £100,000 in miscellaneous receipts. Unlike 1884 the decline is not mainly in the mineral traffic, but in general merchandise receipts. There has been a diminution of about 5 per cent. in the pig-iron production, while the decrease in coal raised is not quite 1 per cent.

In general merchandise the diminution in 1884, was one million tons in a total of 77 millions, in 1883; in 1885, the decrease was over two millions of tons, being only 73,512,000 tons for that year.

In passenger traffic the diminution has been almost exclusively in first and second class fares. The following table speaks for itself:—

	1885 £	1884 £	Inc. or dec. £
First-class	3,243,000	3,481,000	— 238,000
Second-class	2,931,000	3,105,000	— 174,000
Third class	17,58 ,000	17,606,000	— 17,000
Season tickets, etc.	1,822,000	1,763,000	+ 59,000
Excess luggage	4,188,000	4,075,000	+ 114,000
Totals	29,773,000	30,030,000	— 257,000

The receipts per train mile from all kinds of traffic again show a decrease last year, the diminution in receipts from passenger trains is from 49.86*d.* to 48.32*d.*; in goods trains it is from 70.91*d.* to 69.85*d.*; and from passengers, goods, etc., it decreased from 59.65*d.* to 58.19*d.*, almost 1½*d.* per train mile; while as compared with a period of eleven years it is about 9*d.* per train mile. The Board argues from this that the railway companies are doing more work for the public than they formerly did for the same money.

In working expenses there was a decrease of over £400,000. The diminution in net earnings in the two years past has diminished the dividends of the stockholders from £13,700,000 to £12,200,000. The decrease in working expenses has taken place in the face of an increase in train mileage. Comparing 1884 and 1885 the working expenditures per train mile is set down in the report as follows:—

	Cost per train mile 1885 *d.*	1884 *d.*	Inc. or dec. *d.*
Maintenance of way	5.50	5.82	— 0.32
Locomotive power	8.20	8.35	— 0.15
Rolling stock	3.05	3.00	+ 0.05
Traffic expenses	9.86	9.91	— 0.05
General charges	1.43	1.44	— 0.01
Rates and taxes	1.75	1.70	+ 0.05
Government duty	0.31	0.37	— 0.06
Compensation:			
Personal injuries	0.11	0.16	— 0.05
Damage to goods	0.16	0.18	— 0.02
Legal & Parly. expenses	0.22	0.29	— 0.07
Miscellaneous	0.38	0.41	— 0.03
Totals	30.93	31.59	— 0.66

A statement of the net earnings on capital gives 3.83 per cent. for 1885 as against 3.95 per cent. in 1879, the lowest for seven years back; in 1884 the percentage was 3 97

THE *Medical and Surgical Reporter* gives the following interesting facts concerning the water-supply of the European capitals: Rome heads the list with her 204,000,000 litres of pure water every twenty-four hours (her population being 345,036, every inhabitant can dispose of 591 litres per diem); London comes next, for every one of whose 4,085,010 inhabitants there are 300 litres daily; Paris takes the third place, her population amounting to 2,240,124, and each inhabitant having for alimentary uses 58 litres per diem, and for secondary purposes 169,—a total of 227 litres: Berlin has 1,362,283 inhabitants, with 140 litres daily to each: Vienna, 770,172, 100 litres each; Naples, 463,172, with 200 litres; and Turin, 278,598, with 98 litres a head every twenty-four hours.

PERSONAL

FRED J. H. RICKON has been re-elected City Engineer of Little Rock, Ark., for the ensuing term.

H. FERNSTROM has been appointed Chief Engineer of the Chicago, St. Paul & Kansas City R. R., in charge of surveys and construction, with office at St. Paul, Minn.

D. W. LUM has been appointed Assistant Engineer of the East Tennessee, Virginia & Georgia R. R., with headquarters at Knoxville, Tenn.

BENIZETTE WILLIAMS, 171 La Salle street, Chicago, has been appointed by Mayor Harrison consulting engineer to act in conjunction with Engineer RUDOLPH HERING on the Drainage and Water Supply Commission of the city of Chicago.

J. H. PEARSON, Chief Engineer and Superintendent of the Louisville, New Albany & Chicago R. R., has severed his connection with that company and accepted the appointment of Chief Engineer of the Evansville & Chicago R. R.

General Manager GEO. H. NETTLETON, of the Gulf route, has appointed JOHN A. GRANT Chief Engineer of the Memphis, Birmingham and Atlantic Railroad, the new road which was taken possession of by the Gulf a few days ago.

M. A. SLAVEN, late managar of the American contracting and Dredging Co., died in this city, last week, of fever contracted in the Panama Isthmus. Mr. Slaven was a man of exceeding energy, and was the active agent and executive officer of the company which has been doing such good work on the Panama Canal with the "Hercules" type of dredgers. At a meeting of the American Contracting and Dredging Company, held Sept. 19, the following resolution was adopted:

Whereas in view of the recent death of their co-trustee and general manager of this company, Mr. M. A. Slaven, the trustees desire to express their sense of the great loss sustained by the company in the death of one of its founders, who, by his marked ability, sound judgment, untiring energy and devotion, contributed so largely to the success achieved; therefore, be it

Resolved, That the secretary of this company be and is hereby directed to send a copy of this minute to the widow and children of the deceased, with an expression of the sincere sympathy of this Board, each member of which deeply deplores the family's irreparable loss. JAMES J. PHELAN, Secretary.

GURDON S. HUBBARD, SR., the oldest settler of Chicago, died at his home in that city, on the 14th. He was born at Windsor, Vt., in August, 1802, and when thirteen years old went with his family to live in Montreal, Canada. He had just passed his sixteenth birthday when he entered the employ of the American Fur Company, and with headquarters at Mackinac, he made many trips up Lake Michigan to what is now Chicago. The future city had then but two houses, and one of these was Fort Dearborn. He remained with the fur company for a number of years, the latter of which were spent around Fort Dearborn. Until 1834 he traded with the Indians, making long trips into the unbroken forest to the south and west. Then he settled down in Chicago and became one of the most enterprising men in the town.

Mr. Hubbard was prominently identified with many of the great enterprises of the town on the marsh. He built the largest store in the place, and owing to his extensive acquaintance throughout the Wabash country, soon did as much business as all the rest of the stores put together. He was the first to build a warehouse in Chicago, and it was situated at the corner of La Salle and Water streets. It was quite a huge affair, built of brick, and the shrewd ones of that day dubbed it "Hubbard's folly." Mr. Hubbard was also the father of the packing interest of Chicago, packing the first hogs in the winter of 1835-6, the animals slain on that occasion having been driven from St. Clair County, distant over 200 miles. Mr. Hubbard also packed the first beef ever shipped from Chicago, the barrels used for that purpose being brought from Cleveland. He built the original line of lake boats out of Chicago. He was also one of the organizers of St. James's Church, and one of the organizing Directors in the first bank in Chicago—the Chicago Branch of the Illinois State Bank. He was a director, too, of the Chicago Hydraulic Company out of which grew the water-works system.

Mr. Hubbard won all the rewards that were assured to enterprise and industry in those early days, and at one time and another was possessed of a vast deal of property. His wife, a son, and a daughter survive him.

Accidents in Mines.

I.

Method of Working and Ventilation.

The general course and special distribution of the currents of air which are passed through the excavations of a mine bear an intimate relation to the ground-plan of the workings. But the apparatus for generating such currents may be successfuly applied to the various methods of working. The evidence which we have received, and the examples of ventilating apparatus which we have seen in action, have satisfied us that the main problem of producing a strong current in a given direction has been solved; indeed, the progress made in this department by mining engineers and coal owners has been so great, and so successful, as to render it out of the question for us to enter upon an investigation of the subject with any prospect of its material advancement. For deep shafts the special ventilating furnaces, which are used either singly or in combination with fire-grate area of from 50 to nearly 200 square feet, and are fed by fresh air, or by that derived from the purest of the "return" currents, are capable of circulating volumes of air ranging from 200,000 to 400,000 cubic feet per minute. The inefficient furnaces, erected at the surface, of which many were to be seen thirty years ago, are now practically abolished. The mechanical ventilators, which, though mostly ancient in principle, have been developed to their present extent only within the last quarter of a century, are in many instances passing volumes of air amounting to 100,000 and even to 250,000 cubic feet per minute. It is worthy of remark, as illustrating the recent application of mechanical science to the ventilation of mines, that Mr. Kenyon Blackwell, reporting as commissioner to the Secretary of State so lately as 1850, disposed of all apparatus for ventilation other than the furnace and the steam-jet as follows; "The liability to derangement in all machines appears to preclude their use in ventilation, in other than exceptional cases. In mines of large extent it would be difficult, perhaps impossible, to withdraw the workmen in case of breakage, before danger ensued."

Of the mechanical rivals of the furnace many hundreds are now active in British coal mines. The following, which have been the subjects of numerous experiments and discussions by our Institutes of Mining Engineers, may be noted as examples of some of the largest and most effective apparatus :—

Fans in casing: The Guibal, dimensions up to 50 feet diameter by 12 feet, and 46 feet by 14 feet 10 inches. (Hilda Colliery, So. Shields, and Pemberton Colliery, Wigan). The Leeds, 40 feet by 10 feet, (Morley Main Colliery, Yorkshire).

Fans open at circumference: Waddle, 45 feet diameter (Celynen Colliery, Newport, Mon. Ferndale Colliery, 42 feet). Rammell, 32 feet (Shipley Colliery, Derbyshire).

Fan quick running: Schiele, 12 feet diameter to 15 feet 3 inches. (Corton Wood Colliery, and Hoyland Colliery, Yorkshire; Harris' Navigation and Great Western Collieries, and Lewis' Merthyr Collieries, Glamorganshire).

Other ventilators: Struvé, two cylinders of 18 feet 3 inch diameter; stroke, 7 feet. Nixon (Deep Duffryn, Aberdare), two rectangular pistons, 29 feet by 21 feet; stroke, 7 feet. Cooke, two drums of 15 feet in casing of 22 feet diameter (Cleveland, Yorkshire). Roots, generally made only on a small scale; but an exceptionally large one, with two drums of 25 feet by 13 feet, is at work at Chilton Colliery, Durham.

Other varieties, employed in only one or two instances, though possessing features of interest, hardly require to be named.

On the Continent, and particularly in Belgium and Northern France, mechanical ventilators have long been in vogue, and amongst the most largely employed are the Guibal, Lambert, Winter, Pelzer, Goffint, Harzé, and Fabry. The Lemielle of which much was expected 25 years ago, has fallen into disfavor both at home and abroad.

The untoward results, which in several cases of late years have accompanied injury done to the ventilating machine at the surface by an explosion in the mine, illustrate the importance, well recognized among colliery managers, of placing the fan at such a distance from the upcast pit, and of so lightly covering the top of the latter, as to protect the machine and its driving engine from the effects of an explosion. Damage to the fan on such an occasion may mean stoppage of the ventilation and consequent interruption to the work of succor at the most critical time. A valuable precaution often adopted where mechanical ventilators are used is the keeping of a second engine in reserve so that it may be in readiness in case of accident.

The usefulness of jets of compressed air or of steam, or of water under pressure, for local purposes, and especially operations consequent upon accidents, deserves notice. The ventilators of Körting and others which discharge through a conical tube on the principle of Giffard's injector, are highly efficient, but are not of a character to effect the general ventilation of an extensive mine, with due regard to economy.

The methods of producing a current which depend upon diminution of pressure in the upcast shaft are in use in almost all mines of this and other countries. The amount of depression is measured at frequent intervals by the water-gauge or manometer, and ingenious contrivances have been applied for making that instrument self-registering, and for indicating its readings at a distance, as for instance in the colliery office. In order to ensure the constant attention of engineman entrusted with the working of ventilating machines, and to preserve a regular record of the speed of the machine, an indicator should be attached to the engine of such machine automatically, recording the speed of the ventilator, and also the indicators of the water-gauge in the upcast shaft or fan drift.

The opposite method of effecting ventilation, by forcing air down through the down-cast shaft, has been strongly advocated by some few writers; it occasionally receives application to a limited extent or for a local purpose, and it has been adopted for the general ventilation of some collieries in the United States.

The general principles bearing upon the vital problem of the distribution of the ventilating air through the workings of the mine are now becoming well understood, but their adaptation to the particular features of the various modes of working needs constant care and modification. This is more especially the case with the very important principle of having the various currents and splits of air so governed and regulated that whilst leakage of the air from the intakes into the return has to be avoided, there shall also be no tendency for the return air currents to pass through doors or stoppings into the intake air currents.

The larger and more important collieries supply abundant examples of the introduction, by means of numerous "splits" and of large airways, of ample volumes of air throughout all the ramifications of the pit; and of late years the well executed plan drawings which are specially prepared to exhibit the course and length of the different "intake" and "return" currents, testify to the thoughtful attention which is now bestowed on duly supply-

ing the requirements of the different districts of the colliery. But in many parts of the country the inefficient early methods still survive, either of leaving too much of the ventilation to the agency of diffusion alone, or of adhering to, or resting satisfied with, the simple expedient of coursing a single stream of air over too great an extent of ground.

The shortening of the length of the air-courses, combined with the multiplication of their number, has rendered it possible to introduce into our coal mines volumes of air very much greater than those recorded for any continental mine. At the same time it has been objected by continental critics, that from 25 to 50 per cent. of the air descending the downcast shaft is lost by leakage, or devoted to other purposes before the current reaches the working forces where the air is most wanted. We recognize the fact, but consider that as long as a sufficient body of air for the ample dilution of dangerous gases is brought to the face of the coal, the remainder of the air thus leaking away through doors and stoppings frequently serves a useful purpose by preventing stagnation in worked out parts of the mine.

With a view to comparing the resistances offered to the passage of the ventilating air in different mines, the French Commission has supplied a great number of examples founded on the method of "the equivalent orifice," first introduced by M. Murgue. Those examples show that the higher class collieries in Great Britain compare advantageously with those of France, Belgium and Prussia.

The system of working mines in panels or separate districts, where the main air current is split or divided into distinct ventilating currents has amongst other advantages, that of enabling the air necessary for the ventilation of the working places in the district to be adjusted by regulators, fixed in the return airways. This obviates the necessity of separation doors, which from their liability to accident and neglect, are a continual source of danger.

This principle of splitting the air current also brings with it the obvious advantage of greatly shortening the air courses, so that instead of lengths of 20 or 30 miles, which had formerly to be travelled by the current, distances of from two to five miles are now seldom exceeded. This improvement, originated in our larger collieries, is gradually being adopted both at home and on the continent. The condition of many of the mines which a few years ago depended on continuous air-courses of several miles in length, liable to be seriously interrupted by falls of roof, has of late been thereby greatly ameliorated.

In connection with such division of the air-currents, it is notable that in many instances of explosion in a particular seam or district ventilated by a separate split, the men have escaped unhurt from other seams above or below, or from other districts ventilated by separate splits; and it is most desirable that, as far as practicable, the different seams worked in a colliery should be ventilated by separate splits.

The distances from the origin of the air current at the bottom of the downcast shaft, at which the separate "splits" are taken off, the regulation of the volume of air needed for each district, and the arrangement of the several "returns" so as to secure their greatest possible independence, are, as regards limiting the effects of explosions, matters of deep importance.

The very numerous suggestions made for ventilating mines by systems of pipes, render it advisable to state that the liability to accident of such arrangements, and the utter inadequacy of the quantities of air that could be thus introduced, entirely preclude their practical application except in limited and temporary cases, and as an outlet in some instances for the inflammable gases given off from a blower.

The method of breaking down minerals, and the system upon which the workings of the mine are laid out, so as to ensure the greatest safety from accidents to the persons employed, are matters of the highest importance, and although much will depend upon the particular circumstances of each case, yet certain general principles may fairly be regarded as applicable to most cases.

The passing of the Mines Regulation Act of 1862 enacted that there should be two shafts or outlets to each mine containing at one time more than twenty workmen. It is therefore not necessary that we should further refer to that important provision.

In a great number of mines where the coal seams lie comparatively flat, or where the sites for establishing collieries are confined to valleys and where the depth of the shafts increases their costliness, the two shafts necessary for the working of the minerals have generally been placed near together. Owing to the length of time which would be occupied in making a connection between two shafts, if situated at a distance from each other, and to the difficulty of ventilation, this system has become almost universal, as until communication is effected, only a limited number of persons can be employed.

According to the evidence placed before us, which on this point is chiefly limited to expressions of opinion, there would not appear to be any decided advantage in regard to safety, whether the shafts are placed near together or apart, or whether at the rise or at the dip of the coal-field to be worked.

Where mechanical ventilators are adopted, preference is given to the shafts being placed at the rise side of the area to be worked, but, where the ventilation is obtained by furnace heat, shafts at the dip of the workings are preferred, owing to the additional power which is obtained by the increased length of the furnace shaft.

The lie or inclination of the coal-seams in the area occupied by a colliery has some bearing on the direction to be given to the main roadways and principal ventilating currents which pass through them. The specific lightness of the warmer air in the working places of a mine and of the gas which drains into them suggests the guidance of the main current to the deepest point of the workings first, so that its ascent may be continuous until it reaches the exit.

By the Belgian decrees for the regulation of mines, this "Ascensional system" was rendered imperative in that country, except in certain cases for which special permission had to be obtained. It is decreed that "the entirety and the several portions of the works shall be so disposed as not to compel the descent of air more or less charged with inflammable gas."

In a large majority of cases in France and Germany, where like natural conditions occur, a similar system is followed. In some parts of Great Britain the same general view is held, and the provision of an upcast pit "to the rise," or in the shallower part of the seam, is included in the contemplated arrangement of the workings.

In dealing with a small and very narrow area the "ascensional" system may under favorable conditions be the preferable one. Numerous cases, however, unfortunately prove that even such an arrangement is not always sufficient to avert sweeping catastrophes. The physical conditions are occasionally such, as in submarine workings, as to render it practically impossible to sink numerous pits, and there are not a few instances of mines working at the considerable distance of from two to three miles from the shafts with comparative freedom from accident. Nor is it to be overlooked that many of the most destructive explosions have taken place in mines where the extent of the excavations from the bottom of the shafts was very limited.

In many of our coal mines, the main roads start from a pair of shafts placed near together and extend to the workings over a large horizontal area, the main return airways being kept nearly parallel with the intakes. The return air currents are thus brought back to nearly the same point at which the fresh air or "intake" enters the mine, the two currents being in some places kept asunder by means of stoppings, doors and air-crossings, which are liable to destruction by explosions. Such destruction may cause the death of men further in the workings by cutting off the supply of fresh air. The resulting shortening of the air-courses has, however, in some cases, served to clear away the after-damp, and has thus facilitated the rescue or escape of the men.

In many of the modern mines the objection as to leakage is obviated by having two parallel intake air-drifts separated from the return air drifts by a barrier of solid coal, in which the connections occur at very long intervals of, say, 200 to 300 yards.

It is an advantage of this system of working, that having two intake airways one can be used for the engine or main hauling road, and the other for the workmen to travel on, to and from their work, thus obviating the necessity of their doing so on the engine-roads, and consequently reducing the risk of accident from the trains of wagons, engine ropes, and other machinery.

The practice, which to a limited extent is still being carried on in some mining districts, of using the main return air-drifts as engine and travelling-roads for the workmen, when adopted in mines where inflammable gas is given off, is not conducive to the safety of the mine. This practice is, however, by no means so common as it used to be.

The measurement of the volume of air circulating through the different divisions and through the entire mine, requires frequent attention and comparison; thoroughly trustworthy instruments for accomplishing this with accuracy are, however, still wanting, and these matters deserve careful study. The old methods of measuring the velocity of the wind passing through a given area were the wafting of gunpowder smoke, the odor of ether, or the deflection of a candle flame, etc.; but for many years past these methods, some of them not admissible in fiery mines, have been replaced by the use of various anemometers. Among these are some of a very simple character such as that consisting of a sheet of writing paper, the upper edge of which is held by two flat rods of metal, the deflection from the vertical being observed upon a graduated quadrant. The instruments of the late Prof. John Phillips and of Dickinson consist of a hanging vane of thin plate, and they act in a similar manner. For more exact measurements, various forms of revolving anemometers are extensively employed. That of Prof. Combes, of Paris, appears to have been the first, then that of the late Mr. Biram, of Elsecar, introduced about 1840, and made with vanes of oiled silk or thin sheet brass. More recently Casartelli and Casella have brought out instruments of a very delicate character, in which the vanes are of aluminium. In all all these cases the velocity, in terms of the local standard of length, is read off upon dials, which are in some instruments sufficiently

multiplied to give a continuous result, if required, for many hours together.

The well-known anemometer of Dr. Robinson has also been adapted to colliery purposes, and has, like the Biram apparatus, been rendered self-registering; but we are not aware of its being in practical use, nor of any substantial advantage to be gained by substituting it for the other forms.

Some other ingenious applications for the gauging of the air-current, such as the multiplying anemometer of M. Bourdon, on the principle of the "tube of Venturi," and the volume-measuring apparatus of M. Murgue, have been brought into prominent notice by the French Commission, but we are not prepared to recommend their adoption in lieu of the instruments already so largely employed.

The question has sometimes been mooted whether it would not be desirable to insist on a certain minimum quantity of air being supplied to every mine, but more particularly to every colliery, such quantity to be calculated either for the number of men, lights, and horses employed, or on the area of the workings, or on the amount of coal raised in a given time. We have carefully considered these views, and are of opinion that the great variation in the condition of different mines, and the considerable changes that may take place in the same mine render it doubtful whether a hard and fast standard of ventilation could advantageously be employed.

ORDER AND METHOD OF WORKING SUCCESSIVE SEAMS.

As regards safety to workmen, the order in which the several seams of coal should be worked, and the best mode of working them, depend to a great extent upon the particular circumstances in each colliery, and often vary in different districts of the same colliery. It is therefore impossible to lay down general rule applicable under all circumstances.

The different methods are set forth in our preliminary report, and each of those adopted in the several mining districts had its advocates among the witnesses examined. We are, however, disposed to regard the facility for ventilation and other advantages attendant upon the "long wall" system, as ensuring the working of coal with the least danger, wherever such system is applicable.

TO BE CONTINUED.

Guanajuato and its Death Rate of 76 per One Thousand.

Written for ENGINEERING NEWS.

BY EDWARD SAWYER.

It may interest the readers of ENGINEERING NEWS to learn how far the conditions generally recognized as *unsanitary* are observable here.

This city of about 58,000 inhabitants is, situated within the tropics, Lat. 21° N., and is 7,200 feet above ocean level. It is the focus of one of the largest and oldest silver-mining industries in the Western Hemisphere.

I visited it in March last, *i. e.* in the last half of the dry season, when there had probably been no rain of any importance for about five months. It is located in a narrow valley or gorge between naked rocky slopes rising abruptly to heights estimated to range from 800 to 2000 feet. The small river in the bottom of the valley has a very rough and irregular channel, and falls perhaps 150 feet in passing through the thickly settled part of the city,—something near a mile.

The sunshine is of course very hot, and the temperature high during the middle of the day.

So far as my limited observations go, the natural conditions of the place are not unfavorable to health.

Some of the more important artificial conditions, especially the water-supply and sewerage, are typically bad.

The main road up and down the valley is traversed by street-cars, and also by thousands of burros, packing ores and other materials, down from the mountains, and is of course dusty and dirty.

Just at the upper end of the city, the stream is crossed by a stone dam, making a reservoir with an area of several acres. Immediately below this, the channel was dry excepting for small leaks or springs and the contributions from house drains, which begin to enter here. About a quarter of a mile below this, there is another dam forming a long and narrow reservoir, flanked on one side by the main street, and on the other by the Governor's residence and grounds. Most of the city is below this reservoir, and probably supplied with water from or through it; but my information is not certain as to this.

These reservoirs are filled in the rainy season,—mainly by surface water,—which brings in much dust and dirt. In the absence of proof, one may be excused for doubting whether they have been drawn off or cleansed for two or three centuries. At any rate, the water, even in the upper one, seems to be intolerably bad.

According to Mexican custom, the cemetery is situated on the top of a hill and unfortunately, in this case, it is above the upper reservoir and at no great distance from it. It is supposed that the interments here have averaged more than 4,000 per annum for many years past, as the mortality is now greater than that, and the city formerly had about 100,000 inhabitants. I am not aware of any proof that the cemetery contaminates the reservoirs, but their relative locations raise suspicion and are certainly undesirable.

The supply of water for the common people is very meagre. At certain points in the city, where public taps or basins are provided, long lines of people, mostly women and children, can be seen waiting with jugs and pitchers, for their turns. This is a good way to economize water,—ensuring the extreme of niggardliness in its use,—but very poor sanitation.

It seems that through the dry season no filth or waste of any kind is carried away excepting some of the more fluid part which trickles into and down the stream, subject however, to rapid evaporation. The more solid parts accumulate in the drains, sewers and other receptacles or on the surface of the ground. In the center of the city, the stenches from the street gullies and from the nearly dry channel of the stream are very virulent and nauseating.

At the lower end of the city, other streams come in and the dry season flow increases to perhaps 15 cubic feet per second, so that the sewage element is not specially noticeable. Below this the channels are filled with clayey deposit discharged from the great silver reducing works. This material, mixed with dung and litter from stables is extensively used for making adobe walls for houses. It seems not impossible that disease germs, or pathogenic microbes, in the sewage may survive this treatment and thus be introduced into the air of the houses. However this may be, the typical adobe house has but few windows and these as well as the door are tightly closed all night. Under these circumstances, the air of crowded houses must be very bad at the best and simply poisonous at the worst.

It is to be hoped that some engineer, whose travels may take him in this direction, will get more full and exact information as to the points herein raised.

TRADE NOTES.

Activity in Iron and Steel Trade.

PHILADELPHIA, Sept. 19.—President James Swank, of the American Iron and Steel Association, states that the present year will be the most active the iron and steel trade of this country has ever known, not excepting the usually active demand for these products in the year 1880. The demand is reported by him to be uniform and the tone of the market remarkably healthy. He also reports that over one half of the products of iron and steel enters into railroad equipment. The large amount of railroad building yet to be done this year, it is also stated, may take the output of the year in these two metals even beyond present expectations.

A number of instances are reported here of the importation of steel blooms for manufacture into steel rails and other articles. A new southern railroad company has it in contemplation to import blooms for the manufacture of rails for its entire line. This has led to an agitation among the iron and steel interests looking to a better protection for the steel interests by a higher duty upon steel blooms. It is also reported that steel rails are coming into the country largely from abroad, and that more protection is needed for them.

The development of railroads in the interior of this State has been extensive in the last summer and spring. The Pennsylvania Railroad Company has built lateral lines touching mineral and timber lands and purposes to make a number of other extensions which will largely increase the tonnage of the company. Apart from the new lines and feeders, there are no less than twenty short lines being built by companies chartered in the last year.

The Nimble Sixpence.

It has wonderful powers. It can cancel a host of debts. All it needs is to be kept on its travels. Pass it along. The summer has been dull in business. Collections slow; buyers diffident; sellers solicitous and discouraged. Business is improving now but collectors complain hard cash is shy and difficult to catch. The actual reason in many cases is that the debtor has not got it. But in some instances—and too many—people who can pay don't pay. Somhow they hate to part with their money and so hold on to it; some from miserly instincts, others from the more common motive of a desire to take advantage of the dulness to use the money in advantageous speculation upon other men's necessities.

Here is a chance for reform. Let the small debt paying process begin, and begin at once. If A. pays B., then B. can pay C., and C. can pay D., and so on down the alphabetical list of debtors and creditors, until a few dollars have canceled thousands of indebtedness. A dollar is a dollar on its face, but when set in motion it's ten dollars or more. It pays debts, it revives trade, it sets in motion the wheels of industry, it raises hope, restores confidence, builds anew and brings happiness to supplant discouragement. Bless the nimble sixpence and the agile dollar.—*Hawkeye.*

How Our Trade is Slipping Away.

For one English commercial traveller in the Levant, there are 20 Germans and Frenchmen. No orders, however small, appear too insignificant for the German commission houses. In addition to which, German and Austrian manufactures give long credits to their customers, while English firms only do so in isolated cases. They are also more careful in executing orders and according credits, and a general system is established on the Continent of obtaining information respecting the means and standing of small tradesmen, through the principal banking establishments in the country, before transacting business with them. In fact, judging from what is taking place on a small scale in Greece, the trade of the Levant appears to have passed from Englishmen to foreigners. The old English Levant houses have disappeared, and British enterprise with them. The Isthmus of Corinth is being cut and the Copaic lake drained by French companies. The lead and calamine mines at Laurium are also worked by Frenchmen. The smelting of the ancient scoriæ and refuse of the old silver mines at Laurium is carried on by a Greek company, and the Athenian tramways have been constructed and are still managed by a Belgian company. The truth is, the French, Germans and Italians adapt themselves more easily to their foreign surroundings than Englishmen, who, as a rule, expect foreigners to submit to them, and be guided by their fixed methods of doing business, without which no transactions are thought possible. Steam and machinery have done much to equalize competition, and rendered the production of manufactures far easier than formerly. Other countries are now subsequently competing on much more equal terms with England than was the case when skilled manual labor was everything. This competition is far more likely to increase in intensity than diminish: it is, in fact, probably still in its infancy.—*Herapath's Journal.*

WATER

CINCINNATI, O.—The Committee on Water-Works has recommended that the City Solicitor bring suit against the former Consulting Engineer, John W. Hill, for the amount of royalty paid him by Messrs. Wetherill & Co. for two of his patented condensers; that the Solicitor prepare a contract between the city and Messrs. Wetherill and Co. in regard to the arbitration of the differences which have arisen in the construction of the new pumping engines according to the agreement; and that the Superintendent be instructed to make the necessary surveys and recommendations for the construction of equalizing reservoirs at the termini of the water mains at Sedamsville and the Twenty-fifth Ward. These recommendations and others relating to extensions of the mains have been adopted.

SHELBYVILLE, IND., WATER WORKS.—Works consist of a well near Blue river, well 35 feet interior diameter, sunk 23 feet deep in sand and gravel, capacity by actual pump test in twenty-four hours two million gallons: Pump house containing pump chamber, boiler-room, coal shed, work shop and four living rooms for engineer. A pair of compound duplex direct acting Worthington pumps of one million gallons capacity each.

A pair of 50 horse power tubular boilers made by Sinker, Davis & Co. of Indianapolis.

Stand pipe 125 feet high.

Seven and a half miles of mains 12 inches, 10 inches, 8 inches, 6 inches and 4 inches, seventy-four double nozzle hydrants and twenty-five valves. Hydrants and valves made by R.D.Wood & Co. of Philadelphia. Works successfully tested on the 15th of Sept. Col. S. C. Lockett, Chief Engineer, Comegys & Lewis, No. 15, Cortlandt St., Contractors.

AN INTERESTING GEOLOGICAL AREA NEAR BALTIMORE.—Immediately west and northwest of Baltimore there is an oval district of over fifty square miles extent, within which the rocks exhibit a marked contrast to the surrounding gneiss. The rocks of this area are designated as "trap" by local geologists, and the polygonal blocks into which they break up at the surface of the ground are commonly known as "niggerheads." A study of this area has been made by Mr. G. H. Williams, of the Johns Hopkins University, and the results of his labors have been published as Bulletin 28 of the United States Geological Survey, under the title "Gabbros and Associated Hornblende Rocks," and constitutes a valuable addition to what has been known of the changes undergone by igneous rocks. Rocks different in appearance and constitution may, it is shown, be geologically identical. Within the district of fifty square miles mentioned above, unchanged pyroxene rock and its hornblende equivalent occur in the most intimate relations. Just beyond Mount Hope Station, on the Western Maryland Railroad, the "blue cut" affords an excellent exposure where the transitions between the two kinds of rock can be studied with ease.—Baltimore *Sun*.

THE NIAGARA RIVER HYDRAULIC TUNNEL, POWER AND SEWER CO.—According to the prospectus of this company, incorporated March 31, 1886, its purpose is to utilize the enormous power of the Niagara river by constructing a tunnel parallel to the river and about two and one-half miles long, and deep enough to furnish a head of 120 feet near the upper end; the water from the river is to be led to this tunnel by conduits or lateral tunnels upon which will be located the mills etc. The profile shows a tunnel 24 feet in diameter at the outlet and with invert 5 feet above the level of the river below the falls; at one mile from outlet this 24 feet tunnel has an available power head of about 120 feet, with 10,000 horse-power using 58,700 cubic feet of water per minute; at one and one-half miles the tunnel diameter is decreased to 18 or 20 feet diameter and in this half-mile section there is an average head of 107 feet with 60,000 H. P. using 39,800 cubic feet per minute; in the next half mile the tunnel decreases to 16 feet, and the average head is 90 feet, with 25,000 H.P. using 195,600 cubic feet per minute, and in the upper half mile the average head is 80 feet, with 24,000 H.P. using 208,600 cubic feet per minute. In the entire length of two and one-half miles the tunnel falls 105.6 feet or about one foot in 100 feet, the head at the upper end being 79.4 feet, and the total difference of water level between intake above and outlet below the falls is 214 feet. At the mill sites, above the tunnel, race-ways will be run in at right angles to the line of the river and from these shafts and wheel-pits will connect with the tunnel below which thus acts as an escape for the tail-water. The present plan provides for 238 mills of 500 H.P. each. The company proposes to charge $10 per year per horse-power used twenty-four hours per diem which is about one-quarter of the charge elsewhere. Mr. Thos. Evershed, the company's engineer, estimates the cost of the tunnel at $1,212,000, twenty-four cross tunnels at $448,430, four shafts at $38,700, twelve race-ways at $329,927; or, including all incidentals on the above scheme, a total outlay of $2,250,000; the land required would add $75,000 to this estimate of construction, which equals thus $3,000,000 the full amount of the capital stock of the company. The chief officers of the company are Chas. B. Gaskill, President; Francis R. Delano, Treasurer, and Thos. Evershed, Engineer.

Revetment.—The following proposals for constructing a revetment across Smith's Island Bar in the Delaware river between Philadelphia and Camden, were opened September 17th, by Lieut. Col. Henry M. Robert, Corps of Engineers, U. S. A.

NAMES AND ADDRESSES OF BIDDERS.	APPROXIMATE QUANTITIES. Delaware Pine Piles, 18,000 linear feet.	White Oak Piles, 3,400 linear feet.	Yellow Pine Sheet Piles, 75,000 feet, b. m.	Pine Baltens, 16,000 feet, b. m.	Hemlock Plank 24,000 feet, b. m.	Yellow Pine Wales and bearing timbers, 80,000 feet, b. m.	Hemlock Drag Lines, 1,500 linear fe t.	Wrought-iron Re-rods and Screw-nuts with washers, 36,000 pounds.	Cut Spikes 6 in. by ¼ in., 2,000 by pounds.	Chain ½ in. wire, 1,000 pounds.	Total.
	Per lin. foot.	Per lin foot.	Per b. m.	Per 1,000 ft bm	Per 1,000 ft. b. m.	Per 1,000 ft. b. m.	Per lin. foot.	Per lb.	Per lb.	Per lb.	
Herrhoeffen & Vaughan, Wilmington, Del.	22c. $3,960	40c. 1,360	$42 3,150	$45 720	$35 840	$45 3,600	21c. 252	6c. 2,160	4c. 80	7c. 70	$16,192.00
Robert W. Gibson, Philadelphia, Pa.	12½c. $2,250	22c. 748	$35 2,625	$30 480	$22 528	$34 2,720	14c. 168	.03½c. 1,170	.02½c. 50	.06½c. 65	10,804.00
J. P. Evre & Co., Philadelphia, Pa.	15½c. $2.790	25c. 850	$36.90 2,767.50	$33 528	$32 768	$39.60 3,168	17c. 204	.04½c. 1,512	.05c. 100	15c. 150	12,837.50
Nevell & Co., Philadelphia, Pa.	17c. $3,060	23c. 782	$40 3,000	$35 560	$32 768	$40 3,200	13c. 156	.02¾c. 1,620	.06c. 55	60	13,261.00

The bid of Robert W. Gibson was recommended for acceptance.

NEWS OF THE WEEK.

Contracting.

Dredging.—The following bids have been received for dredging the channel in Mobile Bay, Ala.: Peter Burkes, 11⅝ cents per cubic yard; Geo. C. Forbes & Co., 10 cents; Rittenhouse Moore, 9¼ cents; John McGuire, 11¾ cents; S. N Kimball, 15 cents. The bid of Mr. Rittenhouse Moore being the lowest the contract was awarded to him. The work will be made within the late $90,000 appropriation, and the depth will be the uniform one of 17 feet at mean low water; the work will be carried on until the amount of the appropriation is exhausted. The material to be excavated is principally soft blue mud, except in Choctaw pass and Mobile river, where it is principally sand.

Dredging.—The following bids have been received for dredging in the channels leading to the harbor at Baltimore, Md. Elijah Brainard, New York; 13½ and 25.45 cents per cubic yard. Atlantic Dredging Company, Brooklyn, N. Y.: 12.5, 17.5 and 35 cents, Morris and Cumings Dredging Co., New York: 12.5 and 14.1 cents. Geo. C. Fobes & Co., Baltimore, Md.; 10.9, 13. 14.9 cents. National Dredging Co., Wilmington, Del.; 10.1, 12, 15, 16.3 (for the whole work) and 28 cents. Baltimore Dredging Company 13 cents. American Dredging Company Philadelphia, Pa., 13 cents (for the whole work). P. Sanford Ross, Jersey City, N. J.; 10, 12 14¾, 15.2 (for the whole work) and 30 cents.

Opening of Bids for Pile Wharves.—The following bids for building pile wharves in the Harbor of Refuge at Wood's Holl, Mass., were opened by Colonel Elliott on the 17th. Proposals are for the various materials in place; the timber and plank per thousand feet B. M., the iron work per pound, in the following order:—Piles (each), hard pine timber, hard pine plank, spruce timber, spruce plank, wrought-iron, wrought-iron spikes, and cast-iron cleats. The gross amount of each proposal is also given:—

Wm. H. Molthrop & Co., New London, Conn., $6.91; $36.00; $34.00; $24.00. $23.00; 5⅞ : 5⅞c.; 5c.; $6,856.02.

Chas. E. Davis, Wood's Holl, Mass., $8.49; $36.90; $37.40; $26.80; $27.50; 6c.; 5c.; 6c.; $7,664.00.

Donald Gunn, Groton, Conn., $9.00; $40.00; $40.00; $27.00; $26.00; 7c.; 6c.; 6c.; $8,161.00.

Jos. C. Terry, Fall River, Mass., $12.50; $40.00; $38.00; $28.00; $28.00; 6c.; 6c.; 5c.; $9,007.00.

George Gerhardt, East Providence, R. I., $9.60; $53.20; $42.60; $35.94; $36.22; 7c.; 9c.; 5 1½c.; $9,550.70.

George H. Cavanagh, Boston, Mass., $20.00; $40.00; $45.00 $32.00; $32.00; 6c.; 6c.; 5c.; $1,537.00.

Frank Pidgeon Dredging Co., New York, $13.00; $50.00; $50.00; $45.00; $45; 10c.; 10c.; 3c.; $11,895.00.

J. N. Hayes & Co., Boston, Mass., $18.00; $50.00; $50; $30.00; $30.00; 10c.; 10c.; 10c.; $12,320.00.

The bid of the Frank Pidgeon Dredging Co., was not received until three hours after the time set for the opening.

Railroads Bridges and Canals.

Railroads in Switzerland.—At the end of 1884 there were 1,790 miles of railroad in Switzerland, including fifty-nine miles of cog-wheel, cable, or other mountain lines, less than four miles having been added during the previous year. The entire system had cost $205,029,600, including $3,596,380 for the special mountain lines. The cost of the ordinary railroads was $119,325 per mile, and that of the mountain lines, $62,500 per mile. On the 1,790 miles there were 189 tunnels, 1,963 bridges and 656 stations—one to each 2.73 miles of road. The length of double track was 178 miles. Of the ordinary railroads 25.9 per cent was level, and of the mountain road only 8.8 per cent.

A New Railroad for China.—The first railroad contract in China has been secured by an English firm—Messrs. Jardine, Matheson & Co. It is for the construction of a line between Tamsui and Keelung, in Northern Formosa. Since the Franco-Chinese war Formosa has been made a province, and its administration has been committed to the officer who gallantly and successfully defended it—Li Hung Chang. He is now engaged in fortifying it, and as a measure of defense has decided to have a railroad between the two posts mentioned. A large contract for guns, also for Formosa, had previously been secured by the same firm.

Kentucky Cross-breed.—"President Scott, of the Cincinnati Southern road, was a very clever Englishman and much wittier than Englishmen usually are," said a Kentuckian the other day to a *Philadelphia Record* writer. "When he first took hold of the Cincinnati Southern he was greatly annoyed by the claims for horses and cattle killed by trains of the road on their way through Kentucky. It seemed as though it were not possible for a train to run north or south through Kentucky without killing either a horse or a cow. And every animal killed, however scrawny, scrubby or miserable it may have been before the accident, always figured in the claims subsequently presented as of the best blood in Kentucky. 'Well,' said Scott finally, one day, when the 999th claim had just been presented, 'I don't know anything that improves stock in Kentucky like crossing it with a locomotive.'"

Engineering in India.—Railroad extension on the Madras side is going on well. It has been finally decided to commence a line from Arisakere to Hassan, and one from Oossoor, Salem district, to Bangalore. A line from Hyderghaut to Oodapi, in Mangalor is also to be surveyed at once. There is a proposal that the Government of India should erect machinery for the local manufacture of large quantities of rails required for the many miles of railroad yet to be constructed in India. This year will be marked by engineers in India as the "great bridge" year. Of the many important bridges now under construction and approaching completion the following are noteworthy, as showing the magnitude of such work in India: a bridge over the Sutlej, on the Ferozepore Railroad, with twenty-seven spans of 150 feet each: one over the Jumna at Kalpee on the Indian Mid and Railroad, with ten spans of 250 feet each; one over the Jhelum, on the Sind Sarva Railroad, with seventeen spans of 250 feet each: one over the Gunduck, to connect the Tirhoot system with the Bengal & Northwestern Railroad, with eight spans of 250 feet each; one over the Ganges at Benares, on the Oudh & Rohilkund Railroad, with seven spans of 356 feet and nine spans of 114 feet each; and another over the same river at Balawala, with eleven spans of 256 feet each. Another isthat over the Indus at Sukkur now waiting the arrival of the ironwork for a span of 790 feet. The survey of the railroad from Mandalay to Yemethen is completed, and the work of construction will probably be commenced soon. The chief towns in India are beginning to see the advantage of street railroads; the rails for the one at Lahore have arrived at Kurrachee, and the cars are being built by Robson & Co., of Lahore. There is a probability that petroleum will to a great extent supersede coal as fuel for engines, especially for locomotives; trains are now running on the Sukkur line hauled by engines using Beluchistan petroleum, and it is reported that the engineers find no difficulty with this fuel.

Contractors Intelligence,

Reported by T. H. Boorman.

Engineering and Building Materials,

WHOLESALE PRICES.

New York, September 23, 1886.

IRON.

STRUCTURAL IRON.		
Angles	2.00c	@ 2.20c
" steel	2.40	@ 2.50
Tees	2.50	@ 2.60
Beams and channels, American	3.0	@
Tank plates	2 20	@ 2.25
Shell plates	2.50	@ 2.60
Steel plates, Tank	2.70	@ 2.75
WROUGHT-IRON PIPE, PITTSBURG.		
Butt welded, black ..... Discount		45
" galvanized ..... "		35
Lap welded, black ..... "		57½
" galvanized ..... "		40
Boiler tubes ..... "		50
RAILS.		
Steel (large lots at mill)	$34.00	@ $35.00
Old rails	22.00	@ 23.50
Old rails, steel	22.00	@ 23.00
R R. spikes	2.15c	@ 2.25c
R R. splice-plates	1.85	@ 1.90
R R. track bolts, square nuts	2.50	@ 2.75
Barb-wire fencing, galvanized	3.85	@ 3.90
" painted		4.00
Corrugated iron		
Nails		
Iron, per keg	2.00	
Steel do.	2.10	@ 2.20

METALS.

COPPER.		
Lake Superior	11.10	@ 11.15
Other Brands	8.25	@ 9.75
LEAD.		
Com. Domestic	4.75	
Lead Pipe	.06¼c.	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.07¼	
ZINC.		
Sheet	5.60	@ 5.70

BRICK.

Cargoes (afloat)		
Choice Brands	7.25	
Haverstraw ..... per M.	6.50	@ 7.25
Fishkill	6.50	@ 6.62½
Up-River	5.50	@ 6.25
Jerseys	5.75	@ 6.25
Long Island		
Pale	4.50	@ 4.75
FRONTS.		
Croton, red	11.00	@ 15.00
" dark	11.00	@ 15.00
" brown	10.00	@ 14.00
Philadelphia pressed	27.00	@ 28.00
Trenton "	25.00	@ 26.00
Baltimore "	37.00	@ 41.00
Buff "	33.00	@ 35.00
Enameled English	85.00	@ 130.00
" American	80.00	@ 120.00
Fire brick	25.00	@ 55.00
" American, No. 1	30.00	@ 35.00
" " No. 2	25.00	@ 30.00

ASPHALT.

ROCK.		
French, per ton	$20.00	@ 25.00
German	15.00	@ 20.00
According to quantity or brand, and whether taken from vessel or store.		
PAVEMENT.		
Barber's Asphalt	$2.50	@ $3.00

LIME.

Rocklock Cement Co.'s Ground	.80
Rockland, common per bbl	1.00
" finishing	1.20
State, common	.85
" finishing	1.05
Kingston, ground	.90
Add 25c. to above figures for yard rates.	

STONE.

Cargo rates at New York.		
Amherst freestone, No. 1 per cub. ft.	0.95	@ 1.00
" " No. 2 "	0.75	@ 0.85
" " light drab "	0.80	@ 0.95
Berlin " in rough "	0.75	@ 1.00
Berea " "		
Brown stone, Portland, Ct. "	1.00	@ 1.35
" Belleville, N. J. "	0.75	@ 1.35
Granite, rough	0.45	@ 1.25
Common building stone per load	2.00	@ 3.00
se stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@ 3.00
oncrete and macadam stone, Tomkins Cove, per cub. yd		$1.65

SLATE.

Purple roofing per square	6.00	@ 7.00
Green "	6.00	@ 7.00
Red "	15.00	
Black Penna. (at New York) "	4.50	@ 5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@ 20.00
Choice "	65.00	@ 70.00
Tally plank, 1¼ in. 10 in. dres'd, each,	.44	@ .50
Tally boards, dressed com. "	.28	@ .30
SPRUCE, Boards dressed "	.25	@ .28
Plank, 1¼ in "	.28	@ .30
" 2 in. "	.38	@ .40
" 2 in. dressed "	.43	@ .45
Timber per M.	13.50	@ 18.00
HEMLOCK, Boards each.	.18	@ .20
Joist, 2¾ × 4 to 4 × 6 in	.16	@ .44
OAK per M.	55.00	@ 65.00
CYPRESS 1, 1¼, 2 and 2¼ in "	35.00	@ 40.00
YELLOW PINE, Girders "	25.00	@ 30.00
Dressed flooring "	28.00	@ 35.00
SHINGLES, Extra shaved pine, 16in. "		
" sawed 18 in. "	5.75	@ 6.00
LATH, Cargo rate "		2.25

PAINT.

Lead, white, American dry per lb	.04¾	@ .06¼
" " in oil pure "	.07	@ .07¾
" English, B. B. in oil "	.08¼	@ .08¾
" Red, American "	.06¾	@ .07
Litharge "	05½	@ .06
Venetian red, American "	.01	@ .01¼
Indian red "	.08	@ .10
Vermillion, American lead "	.10¼	@ .11½
Paris green "	.15	@ .18
Umber, Amer. raw and powdered per lb.	.01¼	@ .01¾
Drop black, Amer.	.07	@ .13
" " Eng.	.11	@ .13
Chrome green	.10	@ .26
Oxide zinc, American	.03½	@ .03½
" French	.05½	@ .07½

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

CALVIN TOMKINS:		
"Old Newark Co's." Cement		$1.10
BAETJER & MEYERSTEIN:		
Hanover Port.and	$2.60	@ $2.65
BELLONI & Co.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
Burham	2.25	@ 2.50
Fowen	2.25	@ 2.50
BROOKS, SHOEBRIDGE & Co.:	2.45	@ 2.60
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs	2.50	@ 2.75
K. B. & S. " "	2.25	@ 2.50
Stettiner, German	2.65	@ 2.85
Lagerdorfer, "	2.45	@ 2.75
Fiave. A 1, Belgian	2.35	@ 2.50
Roman	2.75	@ 3.00
Keene's Coarse	4.75	@ 5.50
" Fine	7.75	@ 8.50
" Superfine	8.50	@ 10.00
FISHER, ERSKINE W.:		
Stettin (German) Portland Cement	2.40	@ 2.75
GABRIEL & SCHALL:		
Vorwohler "Lion"	2.65	@ 3.10
HUDSON RIVER CEMENT Co. Rosendale		0
JOHNSON & WILSON:		
Saylor's American Portland	2.15	@ 2.45
LESLEY & TRINKLE, Philadelphia, Pa.:		
"Giant" Portland	2.20	@ 2.40
Improved "Union"	1.25	@ 1.50
Union	1.10	@ 1.20
MARCIAL & Co.:		
J. B. White & Bros. Coarse Keene's	4.25	@ 4.50
" Superfine	7.25	@ 7.50
" Portland	2.65	@ 3.00
NEW YORK CEMENT Co.:		
Rosendale		1.10
N. Y. & ROSENDALE CEMENT Co.:		
Rosendale, "Bridge" brand		1.10
SINCLAIR & BAUSON:		
Alsen's Portland Cement Works	2.35	@ 2.85
K. B. & S.	2.25	@ 2.50
STANDARD CEMENT Co		
E. THIELE:		
Dyckerhoff	2.90	@ 3.25
UNITED STATES CEMENT Co.:		
English Portland	2.25	@ 2.40
German "	2.00	@ 2.15
Standard	1.50	@ 1.65
Windsor and Improved Rosendale	1.00	@ 1.10
UNION AKRON CEMENT Co.:		
Akron "Star" brand	1.00	@ 1.10

MARKET SUMMARY.

The Brick Market continues active, good demand with prices firmly maintained; choice Haverstraws command $7.25 and Fishkill have been sold at $6.50 @ $6¾. Jerseys are selling at $5.25 @ $6.25 according to quality. Front brick are in good demand, and Philadelphia sell readily at full rates, Crotons are in fair request. The cement market is rather more active, but large parcels are still reported at 95c. per barrel, with sales of favorite brands at $1.00 to 1.10 per barrel. Portland cement continues to meet with a ready sale, and arrivals are cleared from dock about as fast as discharged, prices varying according to brand and quantity fro $2.10 to 2.50 ex-ship; good expor demand. The Lumber Market is active and Spruce is moved without difficulty at last week's quotations of $13.50 to $16 for random cargoes, specials $16.00 to $18.00. Yellow Pine random $18 @ $19.50, specials $19.50 @ 21.00. White Pine is selling at $28 to 29 00 for S. A. shippers, $15 to $17 for W. I. Box boards $14 to 15. Lath are in great request, both here and at other ports, arrivals few and far between, a sale of 800,000 reported this week at $2.25 with a strong probability of higher prices being obtained if demanded, lack of water renders shipments from the East very slow and causes much annoyance to consumers. Lime is unchanged in price. Dealers are well stocked up and arrivals slightly ahead of demand, but as there is not much on the way the supply and demand balance will be maintained. Hair is in more demand, and fine quality of Goat will probably be higher, choice lots are now selling at 33c. per bu hel, Cattle at 21c. to 22c. The Paint Market is steady at recent quotations, the only change being in the price of Turpentine which has risen to 37½c. @ 38c. per gallon. Plaster is in good demand at $1.20 to $1 25 for ordinary city. The Hardware Market shows no change, dealers report a healthy movement for all standard articles, but prices still show irregularity in di-counts. Nails have been sold only in limited quantities at 2 00@2.10 per keg for 10d to 60d., according to size of invoice. Pig Tin has risen in price and has been a source of considerable speculation with only moderate sales to consumers, 22½c. has been paid for Straits Tin plates are only in moderate request, the importations this year however, show an increase over the same period last year. Lead is not quite so firm and sales are reported at 4.60c.

BUILDING ITEMS.

The Armory Commissioners have decided to recommend the adoption of the plans, with certain modifications, of Mr. George B. Post, for the Twenty Second Regiment Armory, Mr. Post was formerly Colonel of the Regiment. For the Armory of the Eighth Regiment and Second Battery they have selected the plans of Mr. J. R. Thomas, and have requested both architects to submit specifications and estimates.

Mr. Harris C. Blanchard, 145 Broadway, reports plans on the boards for important alterations to Nos. 135 and 137 Broadway, which include the addition of a story to the height, the improvement will probably cost about $15,000, but cost is not yet estimated.

Messrs. D. & J. Jardine have on hand plans for five five-story brick and stone flats with stores, to be built for Mr. John F. Moore, on the southwest corner of Tenth avenue and 108th street, at a cost of about $75,000.

Messrs. Geo. E. Harding and F. P. Dinkelburg have designed for Mr. Wm. Pollock a two-story brick and frame villa, to be built at Pittsfield, Mass., at a cost of about $10,000.

Messrs. Parfitt Bros. of the Garfield Building, Brook'yn, are the architects for a monster store to be built adjoining the new Post Office, Brooklyn, at a probable cost of $1,000,000. it will have a frontage of 136 feet on Washington street and 250 feet on Tillary street, it is to be occupied by Messrs. Losser & Co., and will be built by a syndicate of New York & Brooklyn capitalists.

The Board of Education have re-awarded the contract for the school building on West Fiftieth street, to Thos. Cockerill & Son for $106,000 instead of to Mr. W. H. Walker as previously reported.

Messrs Horace G. Knapp & Co. have on the boards designs for five brick, stone and terra-cotta tenements to be built for Mr. Theodore S. Smith on the north side of 101st street, between First and Second avenues at a cost not yet estimated

Messrs. Chas. Graham & Sons, architects and builders, will erect six first-class residences on the southeast corner of Madison avenue and Eightieth streets, at a cost of about $165,000.

Mr. Lawrence B. Valk, of the Tribune Building, has drawn plans for a brick and terra-cotta M. E. church, to be built at a cost of $16,000 at Wilmington, N. C.

Mr. G. M. Walgrove, is the architect for nine four-story brownstone residences to be built on the south side of Sixty-fourth street, 270 feet west of Ninth avenue, for Mr. Leonard Beockman, at a cost of about $175,000.

Messrs. Wm. Shickel & Co. are the architects for improvements to be made at a cost of $22,000 to St. Joseph's Orphan Asylum northwest corner Eighty-ninth street and Avenue A, also for a one-story brick church to be built for the Capuchin Fathers, at a cost of $7,000, on the south side of 113th street, east of Third avenue.

Mr. W. H. Wood of Newark has drawn plans for a $15,000 residence to be erected for Mr. J. T. Pyle at Morristown, N. J.

No. 125 East Twenty-first street is to have alterations made at a cost of $10,000 from plans of Messrs. R. H. Robertson and A. J. Manning, Clara L. Field, of Irvington, owner.

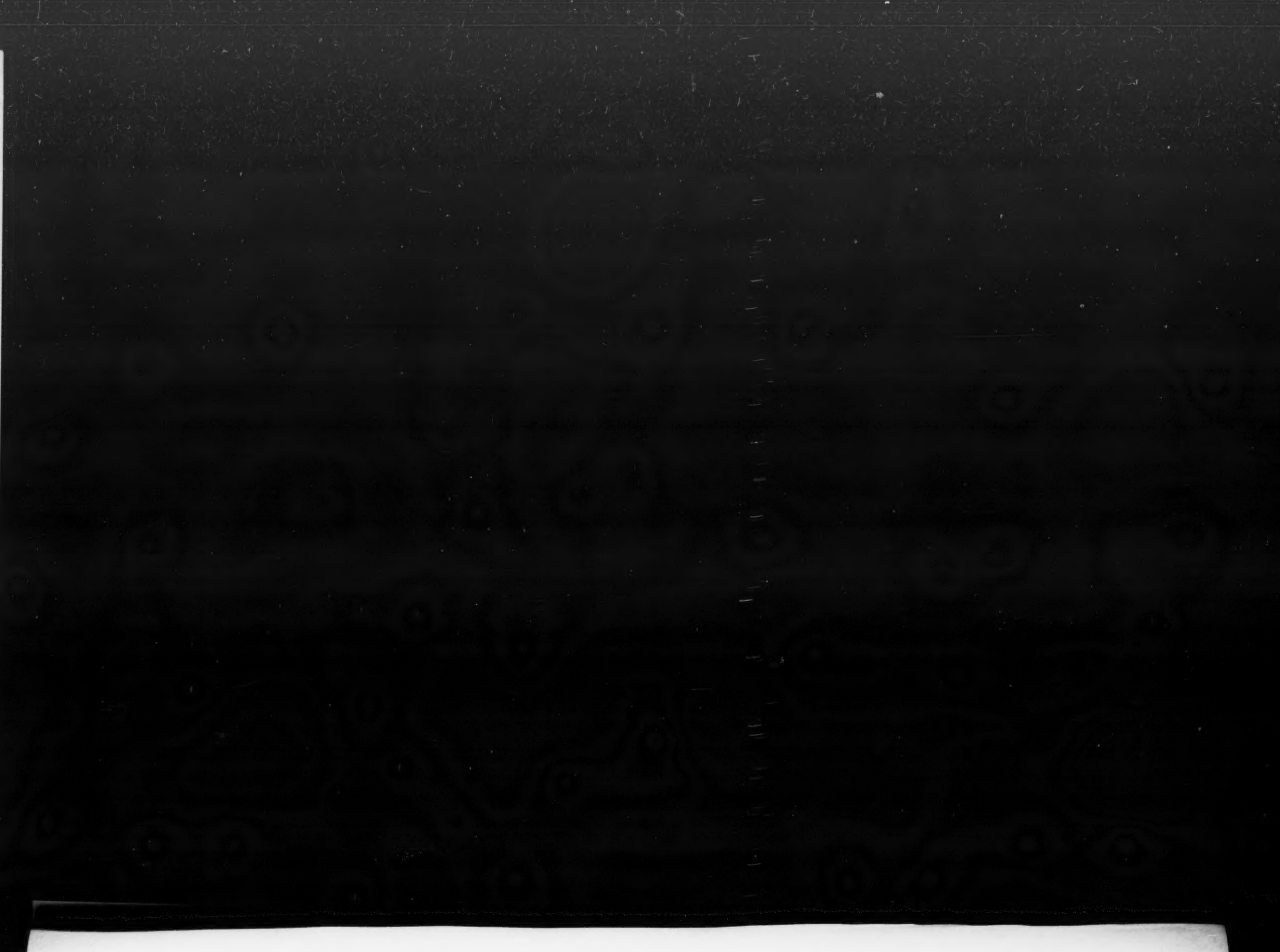
The Police Commissioners have awarded the contract for the erection of their new building on East Sixty-seventh street to James H. Brady for the sum of $82,986.

Messrs. J. C. Cady & Co. have on the boards, designs for six stone and frame residences to be built at an average cost of $6,000 at Fordham Heights, three being for Messrs. Alfred J. Taylor and Wm. D. Peck, one for Mrs. Horace W. Fowler, and two for Mr. Hugh N. Camp. They are also preparing plans for alterations to be made to the Methodist church at Dobbs Ferry, N. Y. at a cost not yet estimated

Mr. Wm. Kuhles informs us that ground was to be broken on the 24th inst for the office building he has designed for the First National Bank of Staten Island, Jas. N. Davis President, which is to be erected at St. George, Staten Island, it is irregular in shape about 70x70, three stories and basement, and will cost about $40,000.

Messrs. Rossiter & Wright 149 Broadway report plans just completed for four brick stone and terra-cotta residences, to be built at a cost of from $18,000 to 20 000 each on Eighty-first street, near Ninth avenue, they are to be built for Messrs. Levi, Frankenheimer and Rosenblott, three houses will have a frontage of 19 feet and two of 21 with depth of 50 feet with extensions. They have also drawn plans for alterations to be made to No. 20 East Twenty-first street, for Mr. F. B. Forster, which will cost about $6,000. For Mr. C. E. Bilqvist they have designed a brick and frame residence to be built at South Orange, at a cost of $10,000 and for Mr. J. G. Holmes a stone house and stable to be built at Pittsburg, Pa., at a cost of $16,000

TRADE NOTES.

MCMAHON, PORTER & CO. have issued a neat catalogue describing the sewer-pipe made by them, and its various uses. Their pipe is salt glazed and vitrified, and is claimed to be as imperishable as glass. The catalogue gives minute directions for laying, its application and strength against crushing when used as railway culverts, carrying capacity of the pipe, cost and numerous other points of interest to users. The Steel patent hand-hole is a new feature worthy of the attention of engineers and others; the opening is oblong, so as to readily permit the introduction of a rod for removing obstructions, and the cover is strong, easily removed but cannot be displaced by accident. Frank Brewer, C. E., Room 25, 44 Broadway, is the New York agent.

FAST LOCOMOTIVES.—Ten passenger locomotives of the fifteen recently built by the Reading Railroad, at the company's shops in Reading, are now in use. It is believed that the new engines can run a mile with a loaded train under forty seconds if necessary, and they are designed to drag eighteen cars instead of the old maximum of six or eight. Two of them are now working on the Philadelphia and Atlantic City R. R., and others are assigned to the main line of the Lebanon Valley, and other divisions.—Philadelphia Press.